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Beyond Self-Reports: A Systematic Review of Neuromarketing Approaches in Exploring Consumer Behavior

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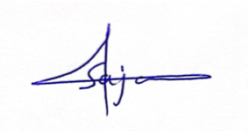
Declaration:

I certify that this thesis submitted for the degree of Master, is the result of my own research, except where otherwise acknowledged, and that this thesis – or any part of the same material – has not been submitted for a higher degree to any other university or institution.

Signed: 

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Abstract

The rapid change in the world of marketing has created a need for a deeper understanding of consumer behavior, which reflects the psychological, emotional, and social processes that shape how people choose, use, and evaluate products and services. Neuromarketing deepens this understanding by uncovering the subconscious drivers of attention, emotion, and decision-making that traditional methods often fail to capture.

Traditional methods, such as surveys and interviews, often overlook the interaction of emotional and analytical processes in decision-making. The System 1 and System 2 framework shows that our choices are shaped by the quick, intuitive reactions of System 1 and the slower, more rational thinking of System 2. Thus, linking marketing and neuroscience through neuromarketing offers solutions to explore how these two modes of thinking interact, using advanced tools that reveal how consumers respond to marketing stimuli.

This thesis presents a systematic literature review (SLR) on the development and practical application of neuromarketing as a tool for understanding consumer behavior. Using a structured review process, 59 peer-reviewed articles were identified and analyzed from PubMed and EBSCOhost. Only articles published in English were included, while editorials and other systematic literature reviews were excluded to maintain focus on original research. These studies were selected based on methodological rigor, relevance, and alignment with the research objectives, ensuring a comprehensive and reliable synthesis of current knowledge in the field.

The review identified seven recurring themes in the literature: consumer preference prediction, brand perception, advertising effectiveness, decision conflict, visual attention, message framing, and interface/e-commerce. These themes emerged from analyzing how tools such as EEG, fMRI, fNIRS, and eye-tracking are applied to assess attention, emotional engagement, mental effort, and both intuitive and deliberate decision processes. Together, they provide richer, real-time insights than self-reports, strengthening the predictive power of marketing strategies.

The findings also point to important methodological considerations in neuromarketing research, particularly the need to update ethical and regulatory frameworks. Key concerns include safeguarding consumer privacy, ensuring informed consent, and managing sensitive data responsibly. Public institutions and regulators should collaborate with academics and industry experts to set standards that promote the responsible use of neuroscience in marketing research. In parallel, higher education and innovation policies can integrate neuromarketing into interdisciplinary curricula and entrepreneurship programs, equipping future professionals to apply these tools with both methodological rigor and ethical responsibility.

Keywords: Neuromarketing, Consumer Behavior, Decision-Making, EEG, Neuroimaging.

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Abbreviations

SLR: Systematic Literature Review

EEG: Electroencephalogram

fMRI: Functional Magnetic Resonance Imaging

GSR: Galvanic Skin Response

fNIRS: Functional Near-Infrared Spectroscopy

ERPs: Event-Related Potentials

PLV: Phase-Locking Value

EDA: Electrodermal Activity

CNN: Convolutional Neural Networks

IAT: Implicit Association Test

ECG: Electrocardiogram

MEG: Magnetoencephalography

BVP: Blood Volume Pulse

PET: Positron Emission Tomography

RESP: Respiration

LPP: Late Positive Potential

xAI: Explainable Artificial Intelligence

ANNs: Artificial Neural Networks

PCN: Posterior Contralateral Negativity

PPG: Photoplethysmography

ALE: Activation Likelihood Estimation

ML: Machine Learning

AI: Artificial Intelligence

DWT: Discrete Wavelet Transform

PSD: Power Spectral Density

BARTT: Brand Association Reaction Time Test

FCR: Field Citation Ratio

Glossary

Neuromarketing: A field that merges neuroscience with marketing to study how the brain responds to branding, advertising, and products, often using tools like EEG, fMRI, and eye-tracking (Alsharif et al., 2021; Lim, 2018; Smidts et al., 2014).

Consumer Neuroscience: A broader scientific area that investigates the neural mechanisms behind consumer behavior, often forming the foundation for neuromarketing studies (Plassmann et al., 2015; Harris et al., 2018).

Consumer Behavior: The way people and groups choose, use, and eventually dispose of products and services in order to meet their needs and desires (Schiffman & Wisenblit, 2019; Solomon, 2016).

EEG (Electroencephalography): A technique that records electrical activity in the brain to study attention, emotional engagement, and decision-making processes (Khushaba et al., 2013; Vecchiato et al., 2011).

fMRI (Functional Magnetic Resonance Imaging): A neuroimaging method that measures brain activity by detecting changes in blood oxygen levels, offering insights into how consumers process marketing stimuli (Plassmann et al., 2007; Zurawicki, 2010).

fNIRS (Functional Near-Infrared Spectroscopy): A portable and non-invasive imaging technique that measures brain activity based on blood oxygenation, often used in naturalistic settings (Chakir et al., 2020; Hirayama et al., 2023).

Eye-Tracking: A method used to monitor where and how long a person looks at visual content, helping marketers understand attention patterns and visual preferences (Wedel, 2013).

GSR (Galvanic Skin Response): A biometric measure that tracks changes in skin conductance, often used to assess emotional arousal in response to marketing stimuli (Venkatraman et al., 2014; Buzeta et al., 2020)

Chapter One : Introduction

1.1 Research Background

Globalization and the recent progress in e-commerce have offered consumers with abundance of alternatives, and transformed them into powerful entities that have a direct impact on the continuity of the company and maintaining its sustainability (Alsharif et al., 2023). As a kind of adaptation to these big changes in marketing, companies have transformed their strategies toward more focus on consumer behavior, looking more to meet their needs, and listening to their demands (Lim & Rasul, 2022).

However, building companies' strategies depending on consumer behavior is still a major challenge in the field of marketing due to the fluctuating nature of consumer opinions, which are influenced by various factors. Hence, the need to use neuroscience knowledge and tools to study consumer behavior has emerged to uncover the underlying causes that influence their behavior, such as emotion, product reputation, price, and other factors (Mashrur et al., 2022).

According to the American Marketing Association (2017), consumer behavior is the study of how individuals and organizations select, purchase, use, and dispose of goods, services, ideas, or experiences to satisfy their needs and desires. It encompasses the psychological, social, cultural, and economic factors that influence decision-making, including both conscious and unconscious processes (Solomon, 2016). Understanding these factors is essential for marketers, as purchasing decisions are rarely based on logic alone; emotions, habits, and situational cues often play an equally important role (Solomon, 2016).

The study of consumer behavior has developed gradually as different disciplines, especially psychology, sociology, and economics, began to contribute their perspectives. Early theories, such as Ajzen's theory of planned behavior, proposed that someone's choices are driven by his personal attitudes, others' expectations, and his sense of control over the situation (Ajzen, 1991). Later, cultural models, such as Hofstede's dimensions, added a broader perspective, explaining how values such as collectivism or individualism influence what consumers find acceptable or desirable (Hofstede, 2001). Recently, the digital environment has become a major driver, as social media and e-commerce have changed how people interact with brands and make decisions (Lemon & Verhoef, 2016).

Building on these cultural and technological perspectives, psychological research has also deepened our understanding of consumer behavior by exploring the mental processes that underlie decision-making. this decision-making process can be better understood through the dual-system framework introduced by Kahneman (2003). System 1 operates quickly and automatically, relying on intuition, emotions, and learned associations. It helps people make rapid judgments and everyday decisions with little effort, but it can also be prone to biases and errors. In contrast, System 2 is slower, more deliberate, and analytical, engaging when situations require careful reasoning, problem-solving, or complex evaluations. In consumer behavior, these two systems often work together; System 1 shapes immediate, instinctive reactions to marketing stimuli, and System 2 provides reflective oversight that can reinforce, modify, or override initial impressions (Kannengiesser & Gero, 2019).

The distinction between System 1 and System 2 aligns closely with the concepts of subconscious and conscious processing. System 1 largely operates at the subconscious level, influencing decisions through automatic and intuitive responses that occur without deliberate awareness (Kannengiesser & Gero, 2019). System 2, on the other hand, reflects conscious processing, where attention is actively directed toward evaluating options and controlling responses (Kannengiesser & Gero, 2019). Recognizing how these systems map onto the brain's conscious and subconscious functions provides a clearer framework for understanding how consumers process marketing stimuli and make purchasing decisions (Kannengiesser & Gero, 2019).

Typically, the human brain processes information collected from the external environment at two levels: consciousness and subconsciousness (Smith & McCulloch, 2012). At the conscious level, we are aware of the external stimuli and we control our response to them, while the subconscious awareness refers to interacting with external stimuli without being actually aware of or having control over our response (Smith & McCulloch, 2012).

Building on this understanding, neuroscience has become a powerful tool for revealing the hidden drivers of consumer behavior, particularly at the subconscious level (Plassmann et al., 2015). It can detect emotional reactions, attention patterns, and decision triggers that often go beyond self-reported data (Plassmann et al., 2015; Hubert & Kenning, 2008). However, it is not a standalone solution. For strategic planning, market segmentation, and understanding broader behavioral patterns, traditional marketing research methods are still essential and valuable (Ariely & Burns, 2010). Therefore, the greatest value is achieved when neuroscience is applied alongside traditional methods, as a complementary approach (Stanton et al., 2017).

While the study of consumer behavior predates modern neuroscience by decades, the scientific exploration of brain responses to marketing stimuli began to gain more attention in the 1990s through the use of techniques such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) (Lee et al., 2007; Smidts et al., 2014). Within this context, *neuromarketing* has emerged as a popular term in the early 21st century, with

one of its earliest academic uses attributed to Allie Smidts in his 2002 inaugural lecture (Smidts, 2002). By the mid-2000s, it was appearing in academic journals, generally defined as the use of neuroscientific tools to better understand how people respond to marketing stimuli in order to bridge the gap between what consumers say and what their brains reveal (Hubert & Kenning, 2008; Plassmann et al., 2012).

Neuromarketing is based on the combination of economics, neuroscience, and psychology. This combination offers a high opportunity to understand consumer behavior and purchasing patterns, providing a reference for more informed decisions on product design, packaging, advertising, and pricing that increase consumer satisfaction, based on the data obtained from neuromarketing techniques. (Adeola et al., 2022).

Thanks to neuromarketing, researchers are now able to understand how emotions and feelings influence consumer behavior, since it has become possible to monitor the emotional changes that consumers undergo during their engagement within an advertisement, including satisfaction or dissatisfaction, this detailed tracking of emotions enables understanding their impact on consumer behavior which explains the acceptance or reluctance of the product (Santos & Santos, 2024). For instance, if the advertisement satisfies a consumer, this may increase the consumer's demand for the product, and vice versa.

Compared to the traditional techniques used in studying consumer behavior, neuromarketing demonstrates distinct advantages when applied in marketing campaigns. It reveals the real-time 'how' for consumer choices of products, as well as the impact of emotion on this behavior, unlike traditional techniques such as questionnaires or interviews, which leave the choice to the consumer to disclose the underlying reasons behind his purchasing decisions, which misleads researchers and leads and lead to suboptimal marketing decisions (Gier et al., 2023).

Since the emergence of neuromarketing, many companies, such as Coca-Cola, Hyundai and PayPal, have started using it significantly to reduce production costs, as from their point of view, analyzing a consumer's brain is less expensive than producing products that do not suit consumers, using inappropriate packaging, or presenting unattractive advertisements (Kikuchi et al., 2021). Therefore, understanding the impact of emotions on consumer behavior using the different neuromarketing techniques helps companies to offer products that better meet their needs and preferences. Consequently, neuromarketing has emerged as an effective and valuable tool for improving companies' resources and increasing their profits. (Nilashi et al., 2020).

Even though neuromarketing has gained momentum in recent years, it is still limited in terms of use, mainly for research purposes in large corporations; therefore, literature related to it remains fragmented, and focusing on individual techniques, which offers a poor, noncomprehensive view of its collective effectiveness. Most of the neuromarketing studies up to date have relied on lab settings for a small sample size of participants, making it difficult to generalize any findings to the marketing consumer society.

Moreover, while neuromarketing's key strength point is its ability to access unconscious responses, few studies have directly compared it to traditional marketing methods. So, what we miss is a broader, up-to-date synthesis of recent neuromarketing research that goes beyond mapping how tools like EEG, fMRI, fNIRS, and eye-tracking are being applied, but also evaluates their actual value in understanding attention, emotion, and decision-making. In our study, we tried to address that gap by systematically reviewing 59 peer-reviewed articles from the last five years, providing a comprehensive perspective of how neuromarketing contributes to consumer behavior and decision making, while also trying to address its limitations and opening avenues for further studies in the field.

1.2 Problem Statement

Although neuromarketing has gained attention in recent years, its use is still mostly limited to research settings, especially within large companies (Ariely & Berns, 2010; Plassmann et al., 2015). As a result, the existing literature often feels scattered, focusing on individual tools rather than offering a full picture of how effective these techniques really are when combined (Smidts et al., 2014).

Many studies have also been based on small, lab-based samples, making it hard to apply the findings to real-world marketing (Lim, 2018). What's still missing is an updated, comprehensive review that not only shows how tools like EEG, fMRI, fNIRS, and eye-tracking are being used, but also evaluates how much they truly help us understand consumer attention, emotions, and decisions (Hsu & Yoon, 2015; Hakim & Levy, 2023). This thesis aims to fill that gap by reviewing 59 recent peer-reviewed articles and offering a clearer view of what neuromarketing can offer, and where it still needs to grow.

1.3. Main Goal and Specific Objectives

1.3.1 Main Goal

The main goal of this study is to review the academic literature on neuromarketing in order to clarify how the field is defined and characterized, identify the main tools and techniques used to study consumer responses, explore how neuromarketing contributes to understanding consumer behavior, and examine how businesses can apply neuromarketing insights to enhance their marketing strategies and decision-making processes.

1.3.2 Specific Objectives

1. To define and conceptualize neuromarketing based on recent academic literature from 2020 to 2025.
2. To identify and classify the main neuromarketing tools and techniques (e.g., EEG, fMRI, fNIRS, eye-tracking) used to study consumer behavior.

3. To evaluate how neuromarketing contributes to understanding unconscious consumer responses, emotional engagement, and decision-making.
4. To compare the advantages of neuromarketing approaches with traditional marketing research methods.
5. To assess the common limitations reported in neuromarketing studies and highlight areas for future improvement.
6. To provide a comprehensive synthesis of selected articles through a systematic literature review methodology, offering updated evidence on neuromarketing's role in marketing effectiveness.

1.4 Main and Specific Questions

1.4.1 Main Research Question

To what extent can neuromarketing techniques effectively uncover and explain the unconscious drivers of consumer behavior?

1.4.2 Specific Research Questions:

1. How is neuromarketing defined in the academic literature, and what are its main characteristics as a field of study?
2. How does neuromarketing contribute to a deeper understanding of consumer behavior, decision-making, and emotional engagement?
3. What are the main tools and techniques used in neuromarketing, and how are they applied to study consumer responses and behavior?
4. How can companies use neuromarketing insights to improve their marketing strategies and better understand consumer behavior?

1.5 Significance of the Study

Theoretical Significance: This study elucidates the concept of neuromarketing and its mechanisms by methodically integrating recent research into a framework that solves a critical gap in the neuromarketing literature. This study integrates various neuroscientific approaches, including EEG, fMRI, fNIRS, and eye-tracking, to evaluate their collective efficacy in revealing subconscious responses, contrasting with prior research that typically emphasizes the use of isolated instruments or limited laboratory tests.

The study enhances theoretical clarity by emphasizing prevailing methodology, consistent findings, and enduring constraints, including small sample sizes and restricted real-world testing, so advocating for a methodological transition from self-reported data to objective neurophysiological measures. Simultaneously, it unveils novel research avenues, encompassing region-specific obstacles and prospects in the implementation of neuromarketing in Palestine.

Practical Significance: The findings provide practitioners with concrete solutions that connect consumer self-perception and subconscious response. The research demonstrates the application of neuromarketing methods to improve marketing efficacy. For instance, utilizing EEG to evaluate emotional resonance before initiating high-cost campaigns, deploying eye-tracking to optimize packaging and website designs, or implementing fNIRS to measure consumer involvement in real-time retail environments. These applications facilitate firms in adopting evidence-based decision-making to mitigate risk and enhance predictive accuracy. The study ultimately views neuromarketing as a complementary tool that enhances the total marketing mix rather than a substitute for traditional research.

1.6 Motivation of the Study

Traditional marketing tools like surveys and interviews often fall short in capturing the full picture of what drives consumer behavior, especially when it comes to emotions and subconscious reactions. As interest in neuromarketing grows, there's a pressing need to understand whether these neuroscience-based methods truly offer deeper insights or if their use remains limited and fragmented. Many studies focus on individual tools without considering the broader impact or practical value of neuromarketing as a whole. In addition, small sample sizes and lab-based experiments make it difficult to apply the findings to real-world markets. This study is motivated by the desire to bring clarity to these questions by reviewing recent academic work, evaluating how neuromarketing techniques are being used, and assessing their actual contribution to marketing research and business practice.

1.7 Outline of the Thesis

This thesis is organized into seven chapters. Chapter 1 introduces the concept of neuromarketing, outlines the research problem and questions, and explains the motivation behind the study. Chapter 2 reviews the scientific background of neuromarketing, detailing its tools, techniques, and practical applications. Chapter 3 describes the systematic literature review methodology, including the databases consulted and the criteria used to select the articles analyzed. Chapter 4 presents the main findings, highlighting research trends and examining how different neuromarketing tools are applied to study consumer behavior and responses. Chapter 5 outlines the study's limitations, addressing methodological constraints, search strategy considerations, and other factors that may have influenced the scope and interpretation of the results. Chapter 6 discusses the findings in depth, linking them to previous studies, drawing out key insights, and addressing broader implications. Finally, Chapter 7 concludes the study by summarizing the main contributions, offering practical recommendations and policy implications, and suggesting directions for future research.

Chapter Two : Literature Review

2.1 Neuroscience

Neuroscience is the scientific study of the structure and function of the nervous system; one of its goals is to find out how neurons operate and coordinate bodily and cognitive functions (Uddin, 2020). With the rapid advancement of brain imaging and electrophysiological recording technologies, researchers have gained the ability to localize and investigate the neural correlates of thoughts, emotions, and affective states, allowing these insights to be applied across various interdisciplinary fields (Kragel et al., 2019).

The human brain functions through a complex network of interconnected neurons, linking multiple regions that operate both independently and collaboratively (Sporns, 2011). While each brain region tends to be specialized for certain tasks, there is substantial overlap and interaction among regions (LeDoux, 2000). For instance, as shown in Figure (2.1), the amygdala plays a central role in processing emotional responses such as fear and pleasure, while the prefrontal cortex is primarily involved in higher-order cognitive functions, including decision-making and behavioral regulation. The hippocampus is essential for associating emotions with memory, whereas the anterior cingulate cortex contributes to emotional regulation and conflict resolution. The ventral striatum is associated with reward processing and motivation, and the thalamus functions as a relay station for sensory information, many of which influence emotional and cognitive processing (Yankouskaya et al., 2022).

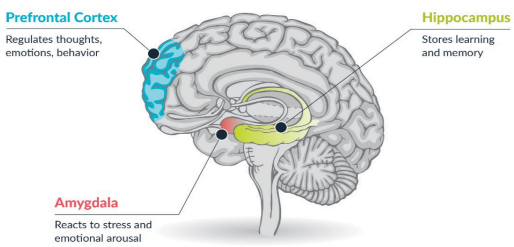

Figure 2.1: Brain structures involved in emotional regulation and fear response

A deeper understanding of how different brain regions influence emotions opens new avenues beyond medical neuroscience (Bhardwaj et al., 2024). One of the most prominent applications is marketing, which can greatly benefit from data provided by neuroscience techniques in order to discover the true drivers of consumer behavior, particularly at the subconscious level (Eijlers et al., 2020). This intersection has led to the emergence of neuromarketing, a field that uses neural data to explore how people emotionally and cognitively react to brands, products, and marketing messages (Zhang et al., 2022).

2.2 Neuromarketing

Definitions of neuromarketing vary slightly depending on the researcher's perspective. Smidts (2002), who first introduced the term, defined it as the use of brain imaging techniques to better understand consumer behavior. Lee et al. (2007) expanded the definition and described neuromarketing as a field that studies the neural processes underlying decision-making, emotion, and motivation in marketing stimuli. More recently, Hubert and Kenning (2008) defined it as an interdisciplinary field that integrates neuroscience, psychology, and economics to understand the mechanisms underlying consumer choices. Although these definitions vary in scope, they all agree that neuromarketing aims to uncover unconscious processes that traditional research methods may overlook (Al-Sharif et al., 2021; Lim, 2018; Bosshard & Walla, 2023).

The development of neuromarketing dates back to the 1990s and early 2000s. When academic researchers used neuroscientific tools, such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG), to study consumer behavior. This work was the cornerstone in understanding how our brain activities affect consumer behavior, mainly the purchase decision-making (Lee et al., 2007; Smidts et al., 2014).

In 2004, an important achievement took place with the famous “Pepsi Paradox” study, which showed that brand knowledge could influence brain activity more than the actual taste of the product. This discovery raised commercial interest in exploring subconscious brand perception and positioned neuromarketing as a promising tool for uncovering hidden consumer preferences (McClure et al., 2004).

Neuromarketing has been adopted commercially since the late 2000s, starting with the usage of the biometric parameters by the brands and the advertising agencies, mainly eye tracking for testing packaging, for example. After that, neuromarketing within the 2010s marked more widespread expansion and showed more adoption across various sectors, including retail, consumer packaged goods, media, and technology (Ariely & Berns, 2010).

From the late 2010s into the early 2020s, the field began to merge with advances in artificial intelligence and predictive analytics. Machine learning platforms, such as Neurons AI, emerged with the promise of estimating attention and emotional responses without always

requiring a lab environment. Since then, neuromarketing has been more accessible to small firms, while before that it was limited to big companies (Venkatraman et al., 2014).

A perspective looks for the future of neuromarketing is likely to be shaped by virtual reality (VR) and augmented reality (AR), accompanied by clearer terms and conditions regulating it, which ensure balanced neuro-neuromarketing strategies, achieving effectiveness with high consumer confidence (Hensel et al., 2017).

As the field continues to evolve, understanding the specific tools and methods used in neuromarketing becomes essential for both researchers and practitioners. These techniques form the foundation of how insights are generated, making it important to explore their functions and applications in detail.

2.3 Neuromarketing Techniques

The brain operates through action potentials, which are rapid changes in electrical charge across the membranes of neuronal cells, allowing for the transmission of information across the nervous system (Bear et al., 2020; Kandel, 2013). Therefore, to measure these activities, it is possible to use two different approaches: either directly recording electrical and magnetic signals through Electroencephalography (EEG), Magnetoencephalography (MEG), and Transcranial magnetic stimulation (TMS), or by measuring the electrical activity indirectly by observing the metabolic activity and the energy expenditure mainly oxygen or glucose signaling from the different brain areas (Plassmann et al., 2007).

The following sections will explore both approaches in detail, beginning with the direct measurement of neural signals.

2.3.1 Electrical and Magnetic-Based Techniques

2.3.1.1 Electroencephalography (EEG)

Electroencephalography (EEG) is a technique to measure the sum of the electrical activity of the whole neurons in the brain through electrodes placed on the subject's scalp. In general, we use around 120 electrodes to cover all brain regions in order to have a complete, accurate picture of the brain activity (Egidi et al., 2008). The big advantage of the EEG is that it is a non-invasive, cheap, comfortable, and portable. Also, it doesn't impact the subject's experience. Over that, it provides very good time resolution of brain processes, where it captures the brain electrical activity every 1 millisecond to 3 milliseconds (Plassmann et al., 2007).

Despite its advantages, Electroencephalography (EEG) also shows some limitations that may affect its suitability for certain types of brain research. First, EEG has relatively low spatial resolution, typically around one centimeter, which means that the technique has

difficulty pinpointing the exact location of brain activity. Second, it is less effective in detecting signals of neurons located on the lateral side of the brain (Egidi et al., 2008).

Applying EEG, it has become possible to measure the electrical activity of the hippocampus, which is the brain region that is responsible for emotions (Ariely & Berns, 2010). Therefore, the application of EEG in neuromarketing is particularly effective in measuring the emotional impact of market stimuli on consumers and how this interaction affects their behavior (Alsharif et al., 2023).

2.3.1.2 Magnetoencephalography (MEG)

Magnetoencephalography (MEG) is another technique to measure brain activity indirectly by measuring the changes in the magnetic field (Egidi et al., 2008). It is superior to EEG as it has much better spatial resolution. But, on the other hand, it is relatively expensive compared to the EEG due to the need for special conditions like a magnetically isolated room in order to place a large magnetometer without being affected by external factors (Ariely & Berns, 2010). Because it requires a controlled environment, this method is particularly used for studying purchasing decisions (Roullet et al., 2008). By replicating real-world shopping conditions, it allows researchers to capture more authentic consumer responses and behaviors, providing deeper insights into what drives decision-making at the point of sale (Roullet et al., 2008).

2.3.1.3 Transcranial Magnetic Stimulation (TMS)

Transcranial magnetic stimulation (TMS) is a tool to stimulate the brain by creating a magnetic field instead of studying the autonomous brain activity (Hallett, 2007). It tends to stimulate or suppress the activity of a specific part in the brain to a depth of 2cm from the surface (Zurawicki, 2010). TMS is mainly used to obtain information from various brain regions and to explore their role in a given thought process, such as decision-making, attention, memory, and emotion (Alsharif et al., 2023). For instance, TMS can be applied to the dorsolateral prefrontal cortex to temporarily disrupt its activity and observe how this affects impulse control in purchase decisions, helping researchers understand whether consumers are making choices based on rational evaluation or emotional impulses (Klichowski & Kroliczak, 2020).

2.3.1.4 Positron Emission Tomography (PET)

Positron emission tomography (PET) is an invasive technique applied exclusively in neuromarketing research (Plassmann et al., 2007). It is based on injecting the participant of a radioactive substance, where the isotopes bind even to the glucose or the oxygen molecules in the blood, accordingly we collect data by the radioactivity from specific regions in the brain, this radioactivity reflecting the metabolic rate in that region, which of course, providing us with accurate information about the functioning of psychological processes (Egidi et al., 2008).

2.3.1.5 Functional Magnetic Resonance Imaging (fMRI)

Functional magnetic resonance imaging (fMRI) is a non-invasive technique that is one of the most applied techniques in neuromarketing due to its accuracy in providing high spatial resolution, even on a scale of 1 to 3 millimeters. Therefore, it provides high-quality data to localize the neural activity (Plassmann et al., 2007).

fMRI operates by generating a strong magnetic field around the brain and detecting how hydrogen protons from human tissue interact with that field (Bandettini, 2012). In the human body, hemoglobin within red blood cells plays a crucial role in transporting oxygen to various tissues, including neural tissue (Liu et al., 2006). When a specific brain region becomes more active, it requires greater metabolic support, leading to an increased flow of oxygenated blood to that area (Liu et al., 2006). fMRI detects changes in the ratio of oxygenated to deoxygenated hemoglobin, known as the Blood Oxygenation Level-Dependent (BOLD) signal, which reflects neural activity indirectly through variations in oxygen consumption over time (Liu et al., 2006). Because of its ability to capture functional changes linked to cognitive and emotional processing, this imaging modality is termed functional (Sanders, 2009).

fMRI, like other techniques, presents some limitations. Most notably, it suffers from low time resolution, capturing brain activity in intervals of approximately five to eight seconds, which makes it unsuitable for recording rapid, real-time neural responses (Plassmann et al., 2007). Moreover, an fMRI scan requires specific conditions, where an individual is supposed to stay motionless, in a noisy environment during the scanning (Plassmann et al., 2007). Besides that, even though individual scanning is not expensive, the capital required for fMRI is still considered relatively high (Ariely & Berns, 2010).

2.3.2 Biometric Techniques

Biometric techniques represent the second approach in neuromarketing, emphasizing the direct monitoring of physiological responses triggered by exposure to marketing stimuli. Among these, eye-tracking is one of the most widely utilized tools (Pezzuti et al., 2015). This method involves closely observing eye reflexes and tracking where a participant is looking, how long their gaze rests on a stimulus, the visual path taken to reach that point, and the degree of pupil dilation (Susan, et al., 2012). This technique is widely used to analyze a consumer's reaction to advertisements or visual stimuli like packaging, colours, or shapes (Zurawicki, 2010).

In addition to eye movement, a wide range of biological indicators is used in neuromarketing, including heart rate, blood pressure, reaction time, and stress-related responses such as cortisol levels and perspiration (Pezzuti et al., 2015). These physiological signals help researchers gain deeper insights into consumers' emotional arousal and

cognitive engagement when exposed to marketing stimuli, offering objective data that complements self-reported measures (Oliveira et al., 2022).

In summary, there isn't a single tool that can fully capture all responses in the brain to marketing stimuli. Each technique has its strengths and limitations. Among them, fMRI stands out as especially valuable because of its high spatial resolution; it can analyze a brain area of just 55 cubic millimeters, which holds around 5.5 million neurons (Hubert & Kenning, 2008). So, rather than relying on one method, it makes more sense to combine techniques. Using them together can give a much clearer and more complete picture of how consumers truly respond.

2.4 Reimagining the 7Ps Through the Lens of Neuromarketing

According to Kotler (2000), the marketing mix is "the set of marketing tools that the firm uses to pursue its marketing objectives in the target market". The marketing mix helps companies form their strategies by analyzing consumer behavior, identifying target segments, and aligning each "P" to address the specific needs and expectations of those segments (Kotler & Keller, 2016; Armstrong et al., 2017). This involves making decisions such as designing products that match customer preferences (Gilal et al., 2018), setting prices that reflect perceived value (Xia et al., 2004), selecting distribution channels that maximize accessibility (Christopher, 2016), and crafting promotional messages that resonate emotionally and cognitively with the audience (Kotler & Armstrong, 2008). By coordinating these elements, firms can create a cohesive offering that is both competitive and relevant in the market (Borden, 1984; Booms & Bitner, 1981).

In the context of neuromarketing, instead of only relying on what consumers declare about their feelings toward a product or a provided service, neuromarketing explores how they truly feel and react, deep down, using tools such as brain scans, eye-tracking, and facial emotion analysis, this helps businesses to make better decisions that connect with people's emotions and instincts (Kolar, 2014).

2.4.1 Product

Product, as defined by Kotler and Armstrong (2008), is "Anything that can be offered to a market for attention, acquisition, use or consumption that might satisfy a want or need. It includes physical objects, services, persons, places, organizations, and ideas." Accordingly, the first element of the marketing mix emphasizes the importance of making the right decision about the market offering (Pourdehghan, 2015).

In today's crowded market, what makes a product successful isn't just how well it works—it's how people feel about it (Nugroho, 2025). Neuromarketing helps uncover those feelings by showing how the brain reacts to specific product details (Reimann et al., 2010). For instance, the way a bottle is shaped or how soft the packaging feels can give off a sense of

comfort or even luxury (Nugroho, 2025). People often don't think about these details consciously, but they respond to them right away (Khondakar et al., 2024).

From this perspective, neuromarketing plays a crucial role in revealing consumer preferences and helping companies design items that people don't just need, but truly desire (Nugroho, 2025). By understanding such subtle cues, brands can create products that feel right and are more appealing from the consumer's point of view, as these elements can trigger a positive emotional response (Kolar, 2014). This emotional connection can often be the deciding factor in whether a product is noticed, remembered, or ultimately chosen (Plassmann et al., 2012).

2.4.2 Price

Price is "the amount of money charged for a product or service, or the sum of the values that consumers exchange for the benefits of using a product or service" (Kotler & Armstrong, 2008). While some customers consider a high price "a loss", other customers link high prices to high quality (Kotler & Armstrong, 2008). This fluctuation in consumer opinion has created a need to explore which prices make consumers feel more comfortable about making a purchase (Saling et al., 2016). For example, using $9.99 instead of $10.00 may sound small, but the brain perceives it differently (Ogata & Sugiura, 2025).

Neuromarketing tools like EEG and fMRI have demonstrated that when people perceive a price as fair, certain brain areas light up — regions linked to trust (Khondakar et al., 2024). Conversely, when a price feels unfair, it can cause discomfort (Plassmann et al., 2012). Companies that understand these facts don't necessarily need to lower their prices; they just need to learn how to present them more effectively (Ogata & Sugiura, 2025). Besides that, businesses can examine how discounts and "limited-time" offers influence consumers' sense of urgency and excitement—insights made possible by understanding how the brain processes perceived value (Saling et al., 2016).

2.4.2 Place

According to Kotler and Keller (2016), "Place includes company activities that make the product available to target consumers." In this context, place also plays a major role—whether it's a store layout or a website interface. Neuromarketing allowed businesses to rely on reliable data to explore how people experience a space (Khondakar et al., 2024). Instead of guessing, companies can now actually see exactly where people look, what they notice first, and what they skip over; they can also detect how the brain responds in the moment (Plassmann et al., 2012; Kolar, 2014).

For example, if shoppers are bypassing a certain shelf in a store or feeling overwhelmed by a crowded menu on a website, tools like eye-tracking and facial coding can detect this (Venkatraman et al., 2014). By using this kind of feedback, businesses can fine-tune details

like lighting, shelf placement, or homepage design in order to guide users and minimize friction during the purchasing process (Kolar, 2014). Ultimately, it's not just about where a product is located, but how easily it can be accessed (Alsharif et al., 2023).

2.4.3 Promotion

Promotion is “the specific mix of advertising, sales promotion, public relations, personal selling, and direct marketing tools that the company uses to persuasively communicate consumer value and build customer relationships” (Kotler & Armstrong, 2008). Neuromarketing can make the difference by measuring how people’s brains react to music, visuals, messages, or even the tone of voice in a commercial. The goal is to make sure an ad doesn’t just grab attention, but also triggers emotions like joy, trust, or excitement, and stays in memory. These emotional reactions are what motivate people to take action, like clicking a link or making a purchase (Kolar, 2014).

Neuromarketing gives companies a way to understand exactly which elements trigger emotional response (Plassmann et al., 2012). For example, EEG or facial expression analysis can show whether a particular scene in a video sparks engagement or causes viewers to lose interest (Khondakar et al., 2024). With this information, marketers can improve their messaging by knowing what actually connects (Venkatraman et al., 2014).

2.4.4 People

People are the employees or staff that customers come into contact with (Wirtz & Lovelock, 2015). These are the ones who represent the company in answering a quick question in a store, helping someone over the phone, or following up after a sale (Zeithaml et al., 2020). Interaction between customers and employees really matters (Bitner, 1995). How someone is treated by an employee can shape their view of the brand, sometimes even more than the product itself (Anshari et al., 2018).

Neuromarketing can help companies understand how things like tone of voice, eye contact, or facial expressions influence customer emotions (Plassmann et al., 2012). This became possible by using tools like EEG and facial coding, in order to track the brain’s and body’s responses in real time (Alsharif et al., 2023). For example, when a customer hears a certain tone of voice in an ad or a customer service call, neuromarketing tools can detect whether that tone creates feelings of trust, comfort, or irritation (Bitner, 1995). A friendly tone may reduce stress signals in the brain, while a harsh tone may activate areas associated with discomfort or rejection (Bitner, 1995).

Similarly, facial expression analysis can reveal how a customer reacts emotionally when an employee avoids eye contact or doesn't smile (Anshari et al., 2018). These findings provide companies with concrete data to build better training programs that focus on emotional impact (Alsharif et al., 2023). In this way, employees can learn how to communicate in ways that truly make customers feel cared for and appreciated (Hakim & Levy, 2018).

2.4.5 Process

Process reflects how easy the customer journey feels. It covers every step the customer takes, browsing, asking a question, signing up, checking out, or even returning a product (Wirtz & Lovelock, 2015). All these steps shape how people feel about the experience. A good process feels invisible (Hakim & Levy, 2018). When it's working well, customers don't notice it at all; they just follow it without being aware (Wirtz & Lovelock, 2015).

This is where neuromarketing becomes valuable. Traditional surveys or self-reports sometimes miss people's true feelings at that moment (Plassmann et al., 2012). Neuromarketing tools, such as EEG or facial coding, can reveal customers' emotional responses at every step (Khondakar et al., 2024). For example, if someone feels anxious at the checkout screen or perhaps gets lost on a product page, these responses can be clearly detected using these tools (Venkatraman et al., 2014). That kind of insight gives companies a real advantage since they can fix the pain points that actually matter, not just the ones customers remember to complain about (Hakim & Levy, 2018).

2.4.6 Physical evidence

Physical evidence includes all the small things that influence how people feel about a service, like the design of a café, the smell in a spa, or even the look of a website (Khondakar et al., 2024). These details may seem minor, but they can strongly shape customer experience (Wirtz & Lovelock, 2015). Neuromarketing helps test whether these elements create positive emotions that make people feel good about the brand (Hakim & Levy, 2018).

Taking advantage of data provided by neuromarketing tools such as EEG, eye-tracking, or facial expression analysis, companies can measure how people actually respond to a place (Khondakar et al., 2024). These reactions are often automatic and can influence decisions before customers are even aware of them. Neuromarketing thus offers a great opportunity for business owners to pay attention to these details and adjust them to consumer preferences (Plassmann et al., 2012).

In summary, applying neuromarketing to the 7Ps helps companies move beyond surface-level marketing. It allows them to design every part of the customer experience—from product and price to people and process, in a way that truly resonates with how the brain works. When brands understand what people really feel, they can create marketing strategies that are not only more effective but also more human.

2.5 Linking Neuromarketing Insights to Brand Development and the 7Ps

Neuromarketing explores how consumer behavior influences the development of consumer preferences and their affinity towards a specific brand or product, as well as the influence of various circumstances on their ultimate decision. Utilizing neuromarketing allows for

evaluating effectiveness, product packaging, design, color selection, and other measures to enhance branding (Boksem, 2015).

Consumers tend to respond more positively to advertisements from brands they recognize and have had good past experiences with. But, on the other hand, unfamiliar brand ads can trigger feelings of uncertainty or distrust (Campbell & Keller, 2003). A notable example is the “Pepsi Paradox” study by McClure et al. (2004), which demonstrated that brand familiarity can influence neural activity more strongly than product taste, highlighting the powerful role of branding in shaping consumer preferences.

From a brand development perspective**,** companies have leveraged neuromarketing to refine product design, messaging, and positioning. Hyundai, for example, used EEG monitoring to gauge drivers’ reactions to newly designed cars, aiming to raise awareness and improve satisfaction before the vehicle even hit production (Lee et al., 2012). This aligns with the Product and Physical Evidence elements of the 7Ps, as consumer-driven design enhances both product appeal and brand trust. Similarly, Microsoft in collaborating with EmSense in the gaming world, using EEG data to analyze gamers’ brain responses to Xbox advertising, optimizing promotional content to boost emotional engagement. (Ariely & Berns, 2010; Lindstrom, 2011).

In the world of financial services, PayPal turned to neuromarketing to better understand what truly motivates users. By comparing how the brain responds to speed versus security, the company discovered that speed had a stronger emotional impact; it made people feel more satisfied and engaged. This insight led PayPal to shift its messaging, putting greater emphasis on the convenience and quickness of its platform (Pérez et al., 2024).

Mini Cooper used fMRI technology to explore how people emotionally react to car designs. The research revealed that childlike features showed more positive responses. This influenced the brand’s decision to highlight those visual elements in its compact car, which is crucial for long-term loyalty (Reimann et al., 2010). Neuromarketing also guides sensory branding strategies. Christian Dior also applied neuromarketing techniques when designing its iconic J'adore fragrance. By using fMRI testing of scent, visuals, and messaging to enhance physical evidence, the company tailored the product to what resonated emotionally with its audience, resulting in widespread consumer appeal (Plassmann et al., 2012).

These cases demonstrate how neuromarketing not only complements traditional research but also uncovers hidden aspects of decision-making that surveys alone cannot uncover (Plassmann et al., 2012). As a result, companies are now designing smarter products, delivering more engaging messages, and building stronger emotional connections with consumers (Plassmann et al., 2012; Venkatraman et al., 2014; Ariely & Berns, 2010).

2.6 Ethical Considerations

Ethics is a set of principles and values that guide the behavior of individuals, focusing on distinguishing right from wrong and helping people make the right decisions. (Beauchamp & Childress, 2019). In the business context, ethics refers to the principles and standards that guide behavior in the world of commerce to ensure that decisions and actions are conducted with fairness and responsibility (Ferrell et al., 2018). Based on this, it has become imperative to address ethical concerns whenever a new field of research or product is introduced to the public (Floridi et al., 2018).

In our modern digital world, collecting and analyzing consumer data has become easier and more accessible through internet browsing patterns, purchase histories, and social media interactions. While this information is valuable for enhancing company performance, it comes with important ethical responsibilities. Therefore, concerns about consumer data security and transparency are growing as consumers become more aware of how their information is used (Martin & Murphy, 2016).

The ethical use of consumer data depends on respecting individuals' privacy and ensuring that their personal information is not exploited for manipulative or intrusive purposes (Calo, 2013). Consumers must be clearly informed about what data is being collected, how it will be used, and who has access to it (Tadajewski & Brownlie, 2009). As a result, regulations such as the General Data Protection Regulation (GDPR) have imposed digital rights to maintain trust between companies and their audiences (Calo, n.d.; Tikkinen-Piri et al., 2017).

In the context of neuromarketing, which has emerged as a novel discipline, there is a real need to adhere to specific guidelines while incorporating neuroscience into marketing activities and studies (Detert et al., 2008). This ensures that ethical standards are maintained while exploring consumers’ subconscious responses (Stanton et al., 2017).

Even though the combination of neuroscience and marketing holds promising potential, it also raises certain criticisms (Fisher et al., 2010). Detractors argue that neuromarketing can manipulate consumers' minds and influence their purchasing decisions, thus raising ethical concerns (Berlińska & Kaszycka, 2016). Therefore, companies should take responsibility and focus on marketing activities and product development rather than using techniques that may unduly influence consumer decisions (Stanton et al., 2016).

Another ethical concern in neuromarketing is the unequal access to advanced and costly technologies such as fMRI, which can create a competitive imbalance between large corporations and smaller businesses (Ulman et al., 2014). As a result, large corporations are often better positioned to invest in high-tech research, gaining an edge over smaller competitors (Murphy et al., 2008).

Accordingly, in 2012, the Neuromarketing Science & Business Association (NMSBA) introduced its Code of Ethics for neuromarketing to ensure a high ethical standard in

neuromarketing research. This code has clearly defined three key elements: integrity, which involves building trust in neuro marketers, safeguarding participants' privacy, and protecting consumers of neuromarketing services (NMSBA Code of Ethics - NMSBA, n.d.).

In conclusion, maintaining ethical integrity in neuromarketing is essential, not only to protect consumer rights and privacy but also to ensure the long-term credibility and sustainability of the field (Ariely & Berns, 2010). For example, in 2011, The New York Times reported on Facebook's use of facial recognition technology for automatic photo tagging, which sparked public concern over user consent and data privacy. Similar concerns have arisen in neuromarketing when companies like NeuroFocus were criticized for collecting EEG data without fully transparent consent, raising debates about consumer autonomy and ethical safeguards (Stanton et al., 2017).

Chapter Three : Methodology

In this study, we conducted a systematic literature review (SLR) to answer our research question in a structured and organised way (Siddaway et al., 2018). We followed the PRISMA guidelines, which helped us stay clear and consistent during the process (Tranfield et al., 2003). We started by setting our research questions, then applied specific inclusion and exclusion criteria to decide which studies to include.

This helped us narrow down the literature to a focused set of relevant articles. Then, we analyzed them based on how useful and related they were to our topic. From there, we summarized the main findings, pointed out the tools most often used in neuromarketing, and showed how they are applied in practice. We also identified some gaps and gave suggestions for future research.

3.1 Data Collection

The first step of this systematic literature review (SLR) involved retrieving relevant peer-reviewed articles from two reliable academic databases: PubMed and EBSCOhost. To ensure the search stayed relevant to our research question, we searched for the terms "neuromarketing" or "consumer neuroscience" within the title and abstract fields. Then we limited the period of publications to (2020 - 2025), a period marked by noticeable growth in neuromarketing research. Only articles published in English were considered.

After that, articles were downloaded and prepared for further screening based on predefined inclusion-exclusion criteria. These criteria were applied to verify that each study fell within the scope of our investigation and contributed meaningfully to understanding the effectiveness of neuromarketing tools in interpreting consumer behavior.

3.2 Data Selection Criteria

After collecting the initial set of articles, the next step was to screen the articles for eligibility. The inclusion criteria for this review required studies to be published in English, in article format only, and between the years 2020 and 2025. Studies were excluded if they were editorials, book chapters, or already existing systematic literature reviews. These criteria ensured that only recent, peer-reviewed research articles directly relevant to the research

objectives were considered. The selected articles were then imported into Rayyan which is a web-based tool that helps researchers organize and streamline the screening process for systematic reviews, but it does not automatically select articles; instead, it simply facilitates the researcher's own decision-making (Rayyan, n.d.).

The first step in the screening process was reviewing the title and abstract of each article to check whether each study addressed our research questions and fit within the defined scope. Articles that met these criteria were then read in full to confirm their relevance, especially in terms of how they applied neuromarketing techniques to better understand or predict consumer decision-making.

This multi-stage process, aligned with PRISMA guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), resulted in the inclusion of 59 articles. The full process, covering identification, screening, and inclusion, is summarized in Figure (3.1).

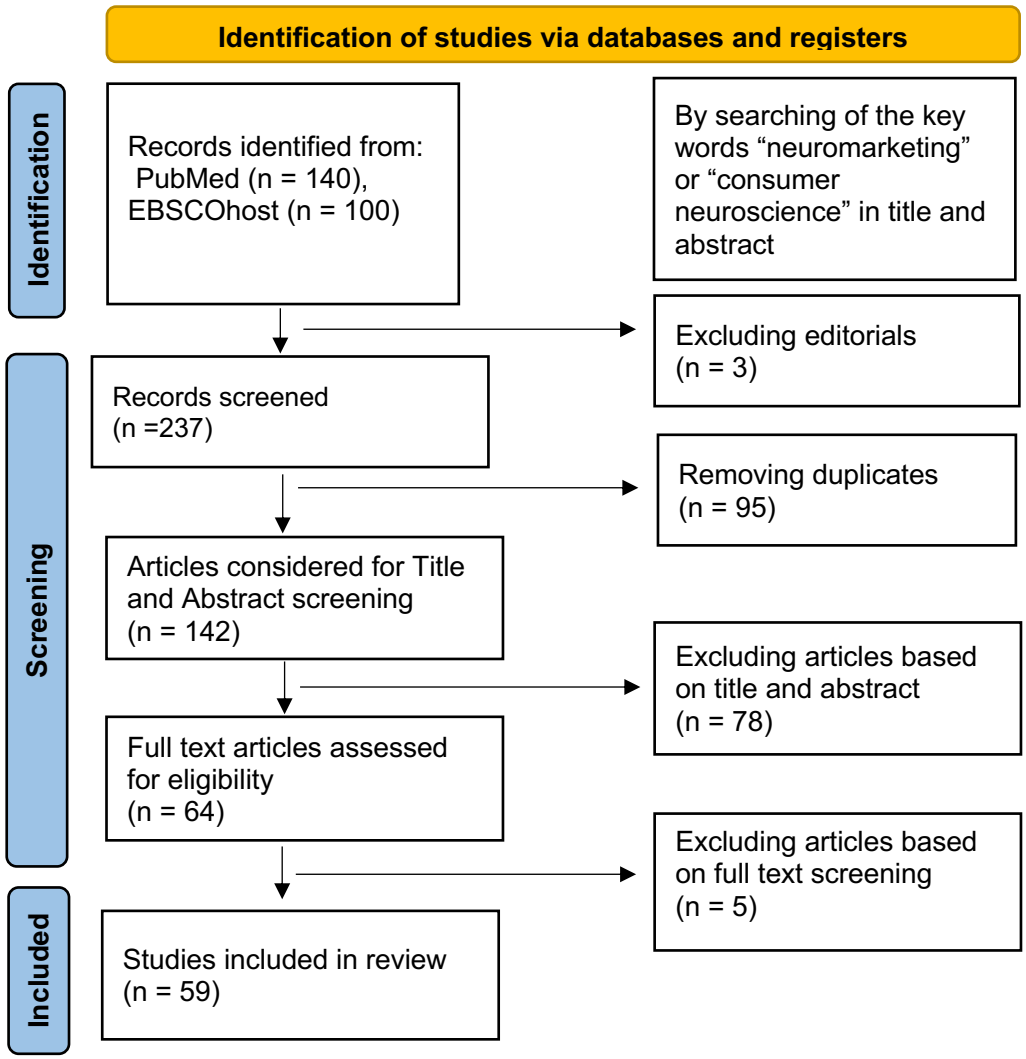

Figure 3.1: PRISMA flow chart for selecting publications for the systematic review

Chapter Four : Results

4.1. Leading Authors in Neuromarketing

Using publication data retrieved from Dimensions.ai, which is a comprehensive research database and analytics platform that provides access to scholarly publications, citation data, grants, patents, and clinical trials. It is widely used by researchers to track academic output, analyze trends, and identify key contributors in specific fields (Dimensions.ai). Table 4.1 shows the most productive researchers who have consistently contributed to the development of neuromarketing during the period (2020-2025). The list includes authors from a range of countries and institutions, which reflects the international and multidisciplinary character of the field.

At the top is Ahmed H. Alsharif from the University of Technology Malaysia, who has published the highest number of articles. He is followed by Hera Antonopoulou from the University of Patras in Greece and Weng Marc Lim from Sunway University in Malaysia, both of whom have also been very active in recent years. Other frequently publishing authors are Enrique Bigné from the University of Valencia in Spain and Michela Balconi from the Catholic University of the Sacred Heart in Italy.

It is noteworthy that several institutions appear more than once, such as the University of Patras and the Catholic University of the Sacred Heart, suggesting the presence of a strong research focus in these institutions.

Table 4.1: Leading Authors in Neuromarketing

Author	Affiliation	Articles	Country
Ahmed H. Alsharif	University of Technology Malaysia	30	Malaysia
Hera Antonopoulou	University of Patras	26	Greece
Weng Marc Lim	Sunway University	24	Malaysia
Enrique Bigné	University of Valencia	22	Spain
Michela Balconi	Catholic University of the Sacred Heart	19	Italy
Nor Zafir Md Salleh	University of Technology Malaysia	19	Malaysia
Jorge Henrique Caldeira De Oliveira	Universidade de São Paulo	15	Brazil
Margherita Zito	IULM University	15	Italy
F Carducci C Babiloni	Sapienza University of Rome	15	Italy
Evgenia Gkintoni	University of Patras	15	Greece
Laura Angioletti	Catholic University of the Sacred Heart	14	Italy

4.2 Publication Evolution in Neuromarketing: 2005–2025

This section discusses the annual number of publications related to neuromarketing from 2005 to 2025, based on data extracted from the Dimensions.ai database. Figure (4.1) shows a steady increase in scholarly interest in the field over the past two decades. The data also shows that the number of publications increased steadily between 2005 and 2015, reflecting a growing academic interest in neuromarketing as an emerging field that brings together neuroscience and marketing. The field experienced more rapid growth around 2016, with particularly high acceleration after 2020. This acceleration may be due to several factors, including easier accessibility to neuroimaging tools (such as EEG and fMRI), rising interest in consumer behavior analytics, and the encouraging adoption of neuroscience-based approaches in commercial sectors.

The number of publications peaked in 2024, reaching over 1,100, which marks the highest output in the observed timeframe. The apparent drop in 2025 is likely because the year is still in progress at the time of data collection, and not all publications have been indexed yet.

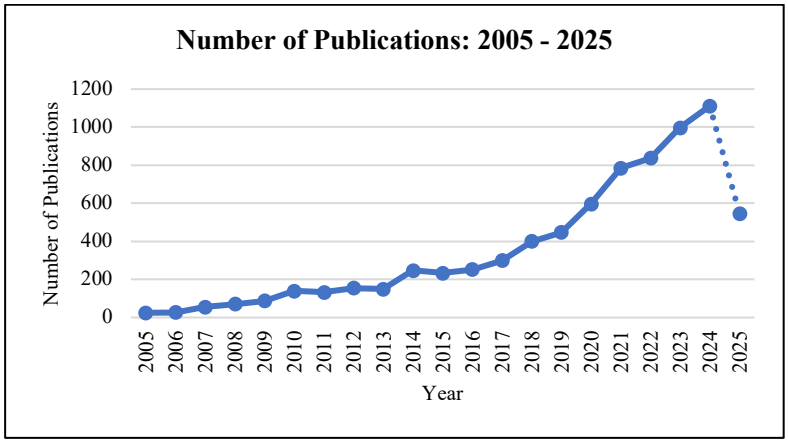

Figure 4.1: Number of neuromarketing-related publications from 2005 to 2025

4.3 Key Contributions to Neuromarketing (2020–2025)

Referring to the Dimensions.ai database, Table (4.2) presents the top influential works in the field of neuromarketing in recent years. The top 10 most-cited articles were identified by searching across three domains: marketing, neuroscience, and psychology. The results show that Aldayel et al. (2020) received the highest number of citations, with 159 citations for their article "Deep Learning for EEG-Based Preference Classification in Neuromarketing". The lowest on the list was Sung et al. (2019), with 14 citations for their article "What Can Neuroscience Offer Marketing Research?"

Field Citation Ratio (FCR) was also included in order to show how frequently a publication is cited compared to other works in the same field and year. This combination of total number citation and FCR, helps to ensure that the selected studies are impactful within the domain.

Table 4.2: Key Contributions to Neuromarketing (2020–2025)

No.	Citation	Title	Journal	Total Citations	FCR	Year
1	Aldayel et al. (2020)	Deep Learning for EEG-Based Preference Classification in Neuromarketing	Applied Sciences	159	42	2020
2	Bazzani et al. (2020)	Is EEG Suitable for Marketing Research? A Systematic Review	Frontiers in Neuroscience	87	17	2020
3	Alsharif et al. (2021)	Neuroimaging Techniques in Advertising Research: Main Applications, Development, and Brain Regions and Processes	Sustainability	83	22	2021
4	Alsharif et al. (2021)	Neuromarketing Research in the Last Five Years: A Bibliometric Analysis	Cogent Business & Management	80	29	2021
5	Meyerding & Mehlhose (2018)	Can Neuromarketing Add Value to Traditional Marketing Research?	Journal of Business Research	78	22	2020
6	Hsu & Chen (2020)	Neuromarketing, Subliminal Advertising, and Hotel Selection: An EEG Study	Australasian Marketing Journal	77	23	2020
7	Levrini & Santos (2021)	The Influence of Price on Purchase Intentions: Comparative Study between Cognitive, Sensory, and Neurophysiological Experiments	Behavioral Sciences	60	18	2021
8	Aldayel et al. (2021)	Recognition of Consumer Preference by Analysis and Classification EEG Signals	Frontiers in Human Neuroscience	58	16	2020
9	Alsharif et al. (2023)	Exploring global trends and future directions in advertising research: A focus on consumer behavior	Current Psychology	52	32	2023
10	Sung et al. (2019)	What can neuroscience offer marketing research?	Asia Pacific Journal of Marketing and Logistics	51	14	2020

4.4 Summary of The Selected Articles

In order to classify the results in a way that answers our research questions, we will categorize each article based on its primary application context. This clustering approach, where each cluster represents a group of articles that share the same scope or research field, emphasizes how neuromarketing techniques are being applied in real-world marketing domains. The studies were organized into seven key clusters: consumer preference

prediction, brand perception, advertising effectiveness, decision conflict, visual attention, message framing, and interface and e-commerce.

Each cluster identified in this review captures a distinct dimension of neuromarketing research. Consumer preference prediction covers studies that use neuroscientific tools to forecast individuals' product choices before they are made. Brand perception includes research exploring how consumers form cognitive and emotional associations with brands. Advertising effectiveness examines how marketing messages engage the brain and influence attention, memory, and emotional responses. Decision conflict focuses on neural patterns when consumers face competing choices or uncertainty. Visual attention investigates how eye-tracking and neural measures reveal where and how consumers focus on stimuli. Message framing analyzes how positive or negative presentation of information alters cognitive and emotional processing. Finally, interface and e-commerce addresses how digital platforms, website designs, and online shopping environments influence consumer decision-making at both conscious and subconscious levels.

Table (4.3) presents each cluster along with the associated studies and core themes they address. A detailed table of our review is attached in Appendix 1.

4.4.1. Consumer Preference Prediction

Brain-based tools can detect what consumers like or intend to buy, even before they make a conscious choice (Raiesdana & Mousakhani, 2022; Qing et al., 202; Jing et al., 2022; Shu et al., 2024; Wang et al., 2022; Russo et al., 2023; Moriya et al., 2024). EEG and fNIRS were commonly used to measure brain activity while participants viewed products or made decisions, showing that specific neural patterns can reliably predict preferences (Mashrur et al., 2022a; Mashrur et al., 2022b).

Machine learning models were applied to data obtained by neuromarketing tools and achieved high accuracy in predicting which products participants preferred, including shoes, cosmetics, cars, and even payment methods (Zeng et al., 2022; Qing et al., 2021; Wang et al., 2022; Wang et al., 2022b). These methods were also able to capture reactions to features like color, price, or design using signals such as the N270 or LPP (Shu et al., 2024; Jing et al., 2022).

Therefore, neuromarketing tools can offer deeper insight into consumer behavior by identifying unconscious signals that shape preference and purchase intention (Gier et al., 2020; Aldayel et al., 2021).

4.4.2 Brand Perception

Attachment to brands involves brain regions linked to both emotional reward and self-reflection, showing that brand relationships tap into deeply personal neural processes (Kikuchi et al., 2021; Zito et al., 2021). Brands that people prefer are recognized by the brain

almost instantly, as early visual areas respond quickly during initial exposure (Santos & Santos, 2024). Memory-related regions, such as the parahippocampal gyrus (PHG) and lingual gyrus (LG), enable automatic reactions to familiar brands (Watanuki, 2021).

Research shows that sounds linked to a brand can subtly influence brain activity, even if people say their opinions about the brand haven't changed (Bosshard & Walla, 2023). In other words, the brain can detect and react to brand cues that people might not consciously notice. Similarly, seeing a brand name or a price can sometimes override someone's initial preference, proving that the context in which a product is presented plays a big role in shaping decisions (Levrini & Santos, 2021).

4.4.3 Advertising Effectiveness

Usage of neuromarketing tools, such as EEG, eye-tracking, can be effective in revealing how different advertising elements stimulate attention and emotion (Eijlers et al., 2020; Zito et al., 2021). Changes in heart rate, pupil size, and facial muscles were able to detect how viewers felt about an ad, even when they didn't express it directly (Lajante et al., 2020; Polo et al., 2024; Yu et al., 2022).

For example, COVID-19 ads caused stronger prefrontal cortex activation than neutral ads (Balconi et al., 2022). Ads with COVID themes increased attention but didn't raise purchase intention; brand familiarity had a stronger effect (Sansone & Balconi, 2022).
UNICEF ads activated emotional and cognitive brain areas and led to a 35% rise in donation behavior (Zito et al., 2021). Similarly, Ads that started with negative emotion and ended with a positive tone were better remembered and triggered stronger emotional reactions (Russo et al., 2022).

In the same context, public service announcements that activated the dlPFC were more likely to influence behavior (Fu et al., 2022). Emotional–cognitive brain regions are activated based on how messages are framed; Loss-framed and inaction-based messages triggered deeper brain activity in emotional–cognitive regions (Gier et al., 2023).

4.4.4 Decision Conflict

Price has a great influence on how consumers assess value and make final decisions, both consciously and unconsciously (Levrini & Santos, 2021). Prices that didn't match the product's real market value triggered strong N400-like responses, brain signals linked to detecting unexpected or mismatched information, and activated the ventromedial prefrontal cortex (vmPFC), which is involved in emotional value evaluation, and the anterior cingulate cortex (ACC), which helps detect and resolve decision conflicts (Gorin et al., 2025). High-priced, discounted luxury items led to stronger purchase intentions than lower prices without discounts and were processed with less cognitive conflict (Jing et al., 2022).

In other contexts, pricing and design continued to affect how people responded (Wei et al., 2023; Kim et al., 2020; Mei et al., 2021). For example, unmatched prices increased P2 brain responses during tourism-related purchases, while fair prices in entertainment contexts led to higher LPP values, which demonstrates how price affects consumer decisions at various stages of the dual-process theory (Wei et al., 2023). Expressive packaging designs caused emotional arousal and faster decisions, but also reduced accuracy (Kim et al., 2020).

Similarly, price and brand information changed initial choices, even when early reactions favored other products (Levrini & Santos, 2021). Mixed promotions that included both discounts and donations created more mental conflict than simple discounts, especially in impulsive consumers (Mei et al., 2021).

4.4.5 Visual Attention

Packaging and product design influenced where consumers looked and how they felt during evaluation (Moya et al., 2020; Juarez et al., 2020). For example, visual features like color and shape attracted more attention and triggered emotional responses during toy packaging decisions (Juarez et al., 2020). When it comes to food packaging, using EEG, GSR, and eye-tracking, combined with declarative methods, offers complementary insights that enhance the evaluation of food packaging (Moya et al., 2020).

Wine labels with stronger contrast triggered early attention-related brain activity that matched participants' later preferences (Alvino et al., 2021). Likewise, chef presentation and dish arrangement increased visual attention and emotional arousal during dining experiences (Mengual-Recuerda et al., 2020). In the cosmetics field, unexpected textures in products activated the right inferior frontal gyrus (IFG), indicating a mismatch between what consumers expected and what they experienced (Hirabayashi et al., 2024).

Physiological signals also supported these results. During tasks like coffee tasting or cosmetic use, brain and body data reflected reported levels of emotion and confidence (Tonacci et al., 2023; Hirabayashi et al., 2021). Expressive visual design in tourism ads influenced both where people looked and how they felt emotionally (Kim et al., 2020). Early EEG markers such as the N270, an electrical brain response that indicates conflict or mismatch during decision-making, also revealed reactions to product color and style during visual decision-making (Shu et al., 2024).

4.4.6 Message Framing

Ecolabels increased activity in the brain's reward region (NAcc) and predicted green purchase decisions, especially among impulsive consumers (Sawe et al., 2022). Positive message framing increased early attention, while negative framing raised emotional arousal in later stages of evaluation (Wei et al., 2024). In a related setting, environmental video

messages improved purchase intention for green products in online shopping (Najafabadiha et al., 2024).

Activation in the dlPFC during public service announcements was associated with stronger behavioral intention (Fu et al., 2022). Loss and inaction frames triggered more activity in emotion and cognition-related brain areas compared to gain or action frames (Gier et al., 2023). Women showed higher purchase rates for original-culture ads than mixed-culture ones; men showed no difference (Duan et al., 2021).

Moreover, increased activation in both reward-related regions (NAcc) and cognitive control areas (dlPFC), leads to stronger purchase intentions for green products (Li et al., 2023). Additionally, messages that combined positive framing with vivid sensory elements elicited greater attention and emotional engagement, while negative framing amplified cognitive evaluation and risk consideration.

4.4.7 Interface and E-Commerce

Consumers respond differently to digital shopping environments (Fici et al., 2024; Wang et al., 2021a; Yen & Chiang, 2021; Santos et al.,2024). For example, shopping in the metaverse was more cognitively demanding than traditional e-commerce (Fici et al., 2024). Likewise, when mobile interfaces were visually unappealing, EEG data showed immediate negative reactions, revealing how users quickly form aesthetic preferences (Wang et al., 2021a). Online ads also influence attention and brain activity depending on how visual cues are arranged, shaping product preference at the neural level (Yen & Chiang, 2021).

Adaptive interfaces, virtual try-ons, and 360° product views increase activation in reward- and attention-related brain regions, making the experience more immersive and enjoyable (Fici et al., 2024; Wang et al., 2021a; Karmarkar et al., 2021). Gamified elements and real-time customization guide visual attention effectively while reducing cognitive load, supporting faster and more confident purchase decisions (Yen & Chiang, 2021; Yu et al., 2022). Additionally, subtle visual and interactive cues, such as dynamic logos and personalized recommendations, strengthen memory retention for products and brands, reinforcing both emotional and cognitive engagement (Šola et al., 2024; Mauri et al., 2021).

These findings align with evidence that the way brands present themselves visually also plays a critical role in shaping consumer engagement and memory (Fici et al., 2024; Wang et al., 2021a; Yen & Chiang, 2021; Santos et al., 2024; Šola et al., 2024). Dynamic logo designs trigger stronger emotional engagement and are easier to remember, especially when it comes to luxury branding (Šola et al., 2025). In livestream commerce, broadcasters' enthusiasm and preparedness enhance consumer engagement (Yu et al., 2022). Finally, delicate differences in web design were capable of being captured through emotional expressions and implicit association tests (Mauri et al., 2021).

Table 4.3: Summary of The Selected Articles

Cluster	Citations	Focus Area	Key Theme
Consumer Preference Prediction	Mashrur et al. (2022a), Mashrur et al. (2022b), Raiesdana & Mousakhani (2022), Mashrur et al. (2021), Zeng et al. (2022), Aldayel et al. (2021), Qing et al. (2021), Jing et al. (2022), Shu et al. (2024), Wang et al. (2022), Russo et al. (2023), Gier et al. (2020), Diao et al. (2021), Moriya et al. (2024), Georgiadis et al. (2023), Rinklin et al. (2022), Cui et al. (2023), Wang et al. (2021b)	Prediction of consumer decisions	Neural signals can forecast preferences and purchase intent
Brand Perception	Santos & Santos (2024), Kikuchi et al. (2021), Bosshard & Walla (2023), Watanuki (2021), Russo et al. (2022), Levrini & Santos (2021), Zito et al. (2021), Šola et al. (2025)	Emotional and cognitive responses to brands and logos	Brands trigger attachment and emotional brain activation
Advertising Effectiveness	Eijlers et al. (2020), Sansone & Balconi (2022), Balconi et al. (2022), Zito et al. (2021), Gier et al. (2023), Fu et al. (2022), Wei et al. (2024), Polo et al. (2024), Lajante et al. (2020), Yu et al. (2022), Aldayel et al. (2021), Kislov et al. (2022), Ausín-Azofra et al. (2021), Barquero-Pérez et al. (2020)	Emotional and neural response to advertising content	Ad engagement depends on emotional arousal and cognitive processing
Decision Conflict	Gorin et al. (2025), Jing et al. (2022), Wei et al. (2023), Kim et al. (2020), Levrini & Santos (2021), Mei et al. (2021)	Consumer response to pricing and promotion strategies	Neural conflict and reward signals guide price-based decisions
Visual Attention	Moya et al. (2020), Juarez et al. (2020), Alvino et al. (2021), Mengual-Recuerda et al. (2020), Hirabayashi et al. (2024), Hirabayashi et al. (2021), Tonacci et al. (2023), Shu et al. (2024), Kocaçınar et al. (2024), Kim et al. (2020)	Sensory design and packaging effects on attention and emotion	Packaging and sensory elements shape attention and experience
Message Framing	Sawe et al. (2022), Wei et al. (2024), Najafabadiha et al. (2024), Gier et al. (2023), Duan et al. (2021), Fu et al. (2022)	Sustainability cues and message framing in marketing	Framing and ecolabels affect neural response and green behavior
Interface and E-Commerce	Fici et al. (2024), Wang et al. (2021a), Yen & Chiang (2021), Šola et al. (2024), Mauri et al. (2021), Yu et al. (2022), Karmarkar et al. (2021)	Neural engagement with digital interfaces and online platforms	Digital layout and delivery influence attention and engagement

Chapter Five : Limitations

Although this study was conducted using a systematic approach, some limitations must be taken into consideration. First of all, the literature search was conducted based on two databases, PubMed and EBSCOhost. While these are reliable databases, neuromarketing, on the other hand, is a field that combines neuroscience, psychology, and marketing. Therefore, relying solely on these academic resources may have excluded relevant studies, which could have broadened the scope of the review.

Second limitation concerning the use of only two main keywords ("neuromarketing" OR "consumer neuroscience"). While these terms captured essential studies of the literature, but this narrow approach may have overlooked studies that used different but related terms. Using synonyms and related terms can broaden the scope of the study and provide more diverse articles.

Finally, as with many systematic reviews, the analysis depends on the quality of available publications. Differences in study design and sample size may have affected the generalizability of the findings. However, these limitations do not detract from the value of the findings, which offer valuable insights into the role and applications of neuromarketing, and also point to areas where future research could improve and expand understanding.

Chapter Six : Discussion

The results of this systematic literature review confirm that neuromarketing is a rapidly growing field and offers significant opportunities for marketing research to provide insights that surpass those of traditional methods. This review also demonstrated the effectiveness of neuromarketing tools, particularly electroencephalography (EEG), functional magnetic resonance imaging (fMRI), functional near-infrared spectroscopy (fNIRS), and eye-tracking, in uncovering unconscious processes that significantly influence consumer decisions.

Unsurprisingly, these findings align with early experimental work by Plassmann et al. (2007) and Ariely & Berns (2010), which demonstrated that consumer preferences are influenced by subconscious stimuli and that neuroscience can offer valuable insights into the unconscious processes behind evaluation.

One of the most significant contributions of recent research is the precision with which neuromarketing methods can predict consumer preference and purchase intention (Karmarkar & Plassmann, 2017). Several of the reviewed studies showed that neural signals, particularly event-related potentials such as; N270, P2, and LPP, can detect emotional conflict, attention allocation, or evaluative consistency even before a decision is consciously made (Mashrur et al., 2022; Shu et al., 2024).

In contrast to early neuromarketing studies, which often focused on isolated lab conditions or hypothetical choices, recent research emphasizes more ecologically valid scenarios. For example, studies examining live-stream commerce, mobile payment, or metaverse shopping environments demonstrate how consumer engagement can now be measured in complex, real-time interactions (Wang et al., 2022; Fici et al., 2024). These studies go beyond the early paradigms used in the 2000s, which were often limited to static stimuli or brand logos, such as in the classic Coca-Cola vs. Pepsi fMRI experiment by McClure et al. (2004). The shift toward real-world emphasizes that neuromarketing became less about decoding brand logos and more about understanding full consumer journeys (Cherubino et al., 2019b), from visual attention to final behavior, where emotions play a major role in shaping decision-making processes (Gorin et al., 2025; Jing et al., 2022; Wei et al., 2023; Kim et al., 2020; Levrini & Santos, 2021; Mei et al., 2021). This is consistent with recent studies' findings, which have shown that activation of regions such as the ventromedial prefrontal cortex, amygdala, and anterior cingulate cortex is associated with brand preference, price satisfaction, or even

response to visual stimuli (Kikuchi et al., 2021; Gorin et al., 2025). It's also important to note that these emotional responses are not always reflected in self-reports or questionnaires (Bosshard & Walla, 2023).

Product presentation context is also important in influencing consumer responses (Kikuchi et al., 2021; Bosshard & Walla, 2023; Watanuki, 2021; Russo et al., 2022; Levrini & Santos, 2021; Zito et al., 2021). Factors such as brand familiarity, cultural background, and product category play a significant role in determining consumer preferences (Santos & Santos, 2024; Rinklin et al., 2022; Hirabayashi et al., 2024). For example, emotional reactions to luxury products vary depending on whether consumers have a prior brand attachment, or consumers may be more likely to favor eco-friendly products if the messages conveyed through advertisements are emotionally charged (Zito et al., 2021; Sawe et al., 2022; Gere et al., 2023).

Emotional content also plays a major role in shaping consumer attention and decision-making as the structure and sequence of emotions in an ad make a measurable difference (Eijlers et al., 2020; Sansone & Balconi, 2022; Balconi et al., 2022; Zito et al., 2021; Gier et al., 2023; Fu et al., 2022). For example, Zito et al. (2021) showed that COVID-related ad content activated stronger emotional responses, while Sansone and Balconi (2022) found that UNICEF campaigns stimulated areas involved in empathy and motivation.

These contextual factors don’t operate separately from the emotional side of decision-making. A consumer’s experience with a brand, their cultural lens, or the way a product is positioned can all shape the emotional reactions that follow. When these elements align with meaningful emotional cues, the message becomes more powerful, and the response more immediate. This overlap between context and emotion becomes especially clear when we look at how advertising is designed to guide both feeling and focus (Ariely & Berns, 2010).

Hence, the overall findings of this review demonstrate how neuromarketing has evolved from a theoretical idea into a practical approach, by integrating neuroscience with marketing, researchers have introduced new, effective ways to explore what truly impacts attention, emotion, and decisions, beyond what people can articulate. Despite this great progress in neuromarketing, one common limitation observed across many of the recent studies is the small sample size. This limitation, also observed in early research, restricts the generalizability of findings across broader populations and diverse markets. Suggested causes include the high cost and complexity of neuromarketing tools, the time-intensive nature of data collection, and the ethical constraints surrounding neuroimaging studies (Eijlers et al., 2020; Sansone & Balconi, 2022). Future work should prioritize more diverse and larger samples to validate existing conclusions.

Chapter Seven : Conclusions, Policy and Practical Implications, and Further Research

7.1 Conclusions

This systematic literature review uncovers the power of neuromarketing over traditional methods in understanding consumer behavior. By analyzing a total of 59 peer-reviewed studies published in the last 5 years, we demonstrate that neuromarketing research has adopted a lot of neuroscience-based techniques such as EEG, fMRI, fNIRS, and eye-tracking recently. These tools provide us with access to the subconscious processes in our minds that govern attention, emotion, and decision-making, elements that the traditional tools like surveys and interviews often fail to uncover.
Findings from this review suggest that neuromarketing provides a more effective prediction of consumer preferences than traditional methods. A key reason for this advantage lies in the use of neural markers such as N270, LPP, and P2, which have been frequently applied to uncover hidden processes related to emotional reactions, mental effort, and decision-making conflict. At the same time, our analysis highlights that consumer responses are affected by emotional and environmental factors, such as the way a message is framed or the familiarity of a brand, which also play a significant role in motivating consumers' responses to marketing stimuli.

On the other side, even though neuromarketing has matured significantly in recent years, it still faces certain challenges that future research should address. One of the most frequently cited issues in the literature is the prevalence of small sample sizes, which is often linked to the high costs, technical complexity, and interpretative demands of neuroimaging methods (Camerer et al., 2018). Another ongoing concern involves ethical considerations, particularly regarding the privacy and potential misuse of neural data (Stanton et al., 2017; Murphy et al., 2020). Addressing these gaps will be crucial for strengthening the reliability, scalability, and public trust in neuromarketing research.

7.2 Policy and Practical Implications

This review could impact several areas: practical, academic, and perhaps public policy. Understanding consumer behavior is at the heart of successful marketing strategies, since it reveals not only what people buy but also why they make those choices. A deeper perception

of these behaviors, especially the subconscious drivers of attention, emotion, and decision-making, allows companies to design campaigns, products, and experiences that align more closely with consumers' real preferences rather than their stated ones.

Practically, this means that companies can leverage neuromarketing to develop smarter strategies that appeal to consumers' emotions. Since traditional marketing relies primarily on consumer self-reports, the use of neuromarketing tools, as demonstrated in the reviewed studies, often provides solutions for a deeper understanding of consumer preferences, and then designing products more aligned with data obtained by neuromarketing tools, which are more accurate and often differ from what consumers disclose. For example, findings in this thesis show that neural measures such as LPP, N270, and P2 can detect emotional responses, cognitive load, and decision conflict within milliseconds, providing a predictive advantage for advertising success and brand preference over declarative methods.

Companies can use tools such as EEG to test the emotional appeal of advertisements before launching large-scale campaigns. Eye-tracking and GSR can help improve packaging and visual interfaces. For example, identifying emotional triggers during advertisements (e.g., through functional near-infrared or pupil dilation) allows marketers to refine messages to make them clearer and more persuasive. Moreover, in multicultural contexts, these insights play an important role, as messages that are accepted in one culture may be misunderstood in another. Therefore, combining neuromarketing with traditional research methods allows companies to optimize campaigns for local audiences while at the same time adapting them more effectively for global markets, reducing cultural misinterpretation.

Academically, this review helps show how neuromarketing can support research by offering a better way to understand what people feel and how they make decisions. It encourages researchers to go beyond traditional surveys and think about how tools like EEG or eye-tracking can give deeper insights. It also suggests that more attention should be given to teaching these tools in marketing and business programs. For instance, the integration of neuroscience-based training can help future marketers interpret subconscious data, bridging the current gap between academic theory and applied marketing science.

More broadly, this study can contribute to public policy formulation. Governments must establish ethical standards for the use of consumer neuroscience in marketing, and ensure their privacy. Since neuromarketing captures unconscious responses, it can create confusion between persuasion and manipulation. Policymakers must ensure transparency and prevent exploitation, especially for vulnerable groups such as children.

Fostering collaboration between marketers, neuroscientists, and data scientists can significantly advance marketing policy. Furthermore, small businesses and emerging markets should be supported in accessing neuromarketing technologies to avoid deepening the competitive gap between large corporations and SMEs.

Thus, this thesis suggests that the application of neuromarketing tools can offer great potential in developing marketing strategies, but its use must necessarily be accompanied by ethical considerations, ensuring equal opportunities, and a clear focus on improving the consumer experience rather than manipulating it.

7.3 Further Research

This review highlighted the important role neuromarketing plays in deepening our understanding of consumer behavior, while also pointing out several areas that still require further investigation. Building on this, a valuable direction for future research is conducting meta-analyses to bring together findings and assess the overall effectiveness of neuromarketing tools. Meta-analyses might determine the effect size of neural predictors such as (LPP, N270, and BOLD fMRI) signals on variables like purchase intention, interest, or brand recall.

This review also pointed to the need for stronger connections between findings across different studies. While actual studies have identified brain regions that respond to emotional stimuli, further research is needed to understand the interconnections between these regions and how they work together during the decision-making process. For example, simultaneous activation of the amygdala and prefrontal cortex might indicate emotional regulation in advertising contexts, while connections between the visual cortex and reward-related regions could explain why certain imagery drives purchasing behavior. Such network-level insights could help design marketing strategies that engage both emotional and rational processing pathways.

Future research should also focus on exploring how cultural background shapes the brain's response to global and local advertising. One fNIRS study on transnational brands found that women were more likely to buy when shown ads in the brand's original culture, while men showed no clear preference (Zhang et al., 2022). Another cross-cultural study comparing U.S. and Chinese consumers showed clear differences in how each group responded to new products, both in subtle, unconscious ways, like gaze patterns and arousal, and in their conscious ratings of attractiveness (Rinklin et al., 2022). These findings make it clear that culture influences not only what people notice and feel, but also what they adress their feelings.

Finally, this study opens the door to future research on why neuromarketing technology remains limited in Palestine. One likely reason is the high cost of neuroimaging equipment, such as EEG and fMRI, making them unavailable to most academic institutions and companies in Palestine. It's also possible to investigate the capability to create relatively inexpensive alternatives, such as portable fNIRS or wearable EEG, or by fostering regional collaborations that enable shared access to infrastructure and expertise.

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Appendix A: Detailed Table of Included Studies in the Review

No.	Citation	Title	Tools	Research Objectives	Key Findings
1	Santos & Santos (2024)	Explainable artificial intelligence (xAI) in neuromarketing/ consumer neuroscience: an fMRI study on brand perception	fMRI + ANNs + xAI	To identify brain networks differentiating preferred versus indifferent brands	xAI-ANNs highlighted functional networks supporting brand perception and early processing stages
2	Mashrur et al. (2022a)	An Intelligent Neuromarketing System for Predicting Consumers' Future Choice from EEG Signals	EEG	To predict consumer choice from EEG while viewing e-commerce products	High accuracy via EEG time/freq/time-freq features with SVM-RFE feature selection -means that EEG can reveal implicit neural markers of future consumer choice
3	Moya et al. (2020)	What Can Neuromarketing Tell Us about Food Packaging?	EEG + galvanic skin response (GSR) + eye-tracking + self-report question naires	To understand how packaging elements affect consumer responses via biometric/neuroscience data	Neuromarketing techniques, when combined with declarative methods, offer complementary insights that enhance the evaluation of food packaging
4	Mashrur et al. (2022b)	BCI-Based Consumers' Choice Prediction From EEG Signals: An Intelligent Neuromarketing Framework	EEG	To develop and validate an EEG-based BCI framework capable of predicting consumers' purchase intention (PI) and affective attitude (AA) towards advertising stimuli	Achieved classification accuracy of 84% for PI and 87% for AA from EEG using ML framework - indicating that BCI-based neuromarketing technology can help brands and businesses effectively predict future consumer preferences
5	Raiesdana & Mousakhani (2022)	An EEG-Based Neuromarketing Approach for Analyzing the Preference of an Electric Car	EEG	To examine consumer preference on choices between cars, including an electric model in order to assess whether	Participants who chose the electric car showed higher PSD and alpha-band coherence in central-parietal and central-frontal brain

				neural signals from brain activity reliably	regions. Clustering based on significant EEG features aligned with self-reported preferences, highlighting the potential of neural measures to
6	Mashrur et al. (2021)	MarketBrain: An EEG Based Intelligent Consumer Preference Prediction System	EEG	To develop EEG-based system to predict consumer choices with various classifiers	EEG and machine learning, especially SVM with an RBF kernel, can effectively predict consumer choices
7	Alvino et al. (2021)	Consumer Neuroscience: Attentional Preferences for Wine Labeling Reflected in the Posterior Contralateral Negativity	EEG (PCN)	To determine whether early attentional signals (PCN) can predict later consumer preferences for wine labels	EEG, through the PCN marker effectively tracks visual attention to marketing stimuli
8	Georgiadis et al. (2023)	NeuMa – the absolute Neuromarketing dataset en route to a holistic understanding of consumer behaviour	EEG + eye-tracking + questionnaires	To create a public, multimodal neuromarketing dataset that supports holistic research on consumer decision-making	Provided rich data enabling future studies on attention, decision-making, and consumer engagement across modalities
9	Mengual-Recuerda et al. (2020)	Neuromarketing in Haute Cuisine Gastronomic Experiences	EEG + eye-tracking + GSR + interviews	To identify which sensory and experiential elements (presentation, dish design, tasting moment, chef involvement) influence emotional consumer's engagement	Showed that chef presentation and dish design led to spikes in visual attention, emotional arousal, and engagement
10	Kikuchi et al. (2021)	Neural correlates of product attachment to cosmetics	fMRI	To explore the neural basis of emotional attachment to cosmetic products and how it mirrors interpersonal attachment mechanisms	highlighted how brain reward and self-related areas activate during product attachment, revealing neural pathways that can guide branding strategies
11	Kocaçınar et al. (2024)	NeuroBioSense: A multidimension	Empatica E4 wearable	To provide physiological neuromarketing dataset	Provided dataset to support research on emotion classification,

		al dataset for neuromarketing analysis	device, including non-invasive PPG, EDA, and body temperature sensors		consumer responses to advertising, and neuromarketing techniques
12	Zeng et al. (2022)	Like/Dislike Prediction for Sport Shoes With Electroencephalography: An Application of Neuromarketing	EEG	To evaluate whether EEG-based models can accurately predict consumer preference (like vs. dislike) for sport shoes	Achieved high prediction accuracy (~94.22%), indicating EEG can reliably capture neural correlates of consumer liking or disliking, highlighting implicit decision signals in neural responses
13	Zito et al. (2021)	Assessing the Emotional Response in Social Communication: The Role of Neuromarketing	EEG + skin conductance + eye-tracking	To compare emotional responses to UNICEF ads	Neuromarketing tools effectively detected emotional responses to non-profit messaging, leading to a 35% increase in donations
14	Sawe et al. (2022)	Neural responses clarify how ecolabels promote sustainable purchases	fMRI	To uncover neural mechanisms by which ecolabels influence sustainable purchase decisions, and to test whether neural markers predict real-world market outcomes	found that the Energy Star label triggered increased activity in the brain's reward region (NAcc), especially in impulsive individuals, predicting purchase decisions
15	Kislov et al. (2022)	Central EEG Beta/Alpha Ratio Predicts Population-Wide -Efficiency of Advertisements	EEG + eye-tracking	To determine whether EEG engagement (beta/alpha ratio), eye-tracking metrics, and behavioral measures from a small sample can predict the real-world effectiveness of digital ads at the population level	The study showed that regression models using EEG (adj R^2 = 0.45) and combined EEG with eye-tracking data (adj R^2 = 0.79) significantly predicted outcomes, while models using only eye-tracking or behavioral data were not significant.
16	Watanuki (2021)	Watershed Brain Regions for Characterizing Brand Equity-	Meta-analysis + ALE + chi-	To identify brain regions linked to brand equity	The parahippocampal gyrus (PHG) and lingual gyrus (LG) are key regions in brand equity processing, with

		Related Mental Processes	square + ML		emotion-driven associative memory from these areas enabling automatic mental responses that differentiate branded from unbranded products
17	Wang et al. (2022)	Pleasure of paying when using mobile payment: Evidence from EEG studies	EEG	To investigate whether mobile payment elicits a neural "pleasure of paying" in8addition to reducing "pain of paying" and how this influences purchase behavior	Mobile payments increased purchase intention compared to cash, for both hedonic and utilitarian products. EEG results showed reduced pain of paying (N300) and increased pleasure of paying (LPP), suggesting that mobile payment enhances buying motivation
18	Karmarkar et al. (2021)	Category Congruence of Display-Only Products Influences Attention and Purchase Decisions	Eye-tracking	To investigate how the presence of matched vs. mismatched product display items on e-commerce pages influences consumers' purchase decisions	Product displays matched to the target category significantly increased purchase likelihood compared to mismatched displays
19	Šola et al. (2024)	Predicting Behaviour Patterns in Online and PDF Magazines with AI Eye-Tracking	Eye-tracking + AI modeling (online/PDF magazines)	To enhance the engagement and usability of college magazines by applying AI-powered eye-tracking technology to understand reader behavior and preferences	showed that AI-based eye-tracking can accurately measure attention, engagement, cognitive load, and clarity with 97–99% accuracy
20	Aldayel et al. (2021)	Recognition of Consumer Preference by Analysis and Classification EEG Signals	EEG (DWT, PSD) + classification algorithms	Evaluate EEG-based methods to detect like/dislike decisions and to improve EEG-based consumer preference detection by evaluating different feature extraction methods (DWT, PSD)	Neural signals captured during passive product exposure can predict expressed preferences ('like' vs. 'dislike'), offering insight into implicit consumer decision-making processes
21	Juarez et al. (2020)	Neuromarketing Applied to Educational Toy Packaging	Eye-tracking + GSR + Semi-structure	To determine which packaging design elements, drive parental attention and emotional response	The most influential elements appear to be the graphic details of the packaging and the perception of a higher

			d interview s	when purchasing educational toys	educational level, which is enhanced as the game presents more questions
22	Fici et al. (2024)	From E-Commerce to the Metaverse: A Neuroscientific Analysis of Digital Consumer Behavior	EEG + skin conductance + BVP + self-report measure	To compare emotional and cognitive aspects of shopping in the metaverse vs traditional e-commerce	Shopping in the metaverse was more cognitively demanding than traditional e-commerce,
23	Eijlers et al. (2020)	Measuring Neural Arousal for Advertisements and Its Relationship with Advertising Success	EEG	To develop and validate an EEG-based neural arousal measure and assess its relationship with external ad success metrics (notability and attitudes)	Ads that evoke higher arousal (lower alpha activity) tend to be more noticeable but are not necessarily viewed more positively
24	Russo et al. (2023)	Neuroselling: applying neuroscience to selling for a new business perspective. An analysis on teleshopping advertising	EEG + Eye-tracking + Self-report questionnaires	To exploring the emotional factors that influence decision-making in response to infomercials	Trust in the seller, attention levels, and brain response patterns strongly affect how engaged consumers feel and how likely they are to make a purchase. Focusing more on important visual elements boosts both interest and willingness to pay
25	Gorin et al. (2025)	Neural Correlates of the Non-Optimal Price: An MEG/EEG Study	EEG + MEG	Explore brain mechanisms for price incongruity in mobile products	Both EEG experiments revealed a strong N400-like brain response to prices that were inconsistent with the actual market value of a mobile phone, indicating perceived incongruity. The MEG experiment confirmed thses findings
26	Balconi et al. (2022)	Consumers in the Face of COVID-19-Related Advertising: Threat or Boost Effect?	fNIRS	To examine how COVID-19-themed commercials influence brain activity related to consumer approach or avoidance motivation	COVID-19-related ads triggered stronger emotional processing in the prefrontal cortex compared to non-COVID ads

27	Rinklin et al. (2022)	Visual Attention to Novel Products - Cross-Cultural Insights From Physiological Data	Eye-tracking + EDA	To explore cross-cultural differences in visual attention and perceived attractiveness toward novel versus familiar products	U.S. and Chinese consumers showed different unconscious (gaze patterns, arousal) and conscious (attractiveness ratings) responses to novel products
28	Gier et al. (2023)	Why it is good to communicate the bad: understanding the influence of message framing in persuasive communication on consumer decision-making processes	fMRI	To uncover the neural mechanisms behind consumers' processing of different message frames	Message framing and object valence influence how consumers process information. Neural data showed that emotional–cognitive brain regions are activated based on how messages are framed
29	Diao et al. (2021)	Electroencephalographic Theta-Band Oscillatory Dynamics Represent Attentional Bias to Subjective Preferences in Value-Based Decisions	EEG (ERPs)	To investigate the temporal dynamics and oscillatory brain activity associated with selective attention to individual preferences during value-based decision-making	Theta-band brain activity reflects attentional bias toward personal preferences, and this effect varies with the degree of value difference between options
30	Sansone & Balconi (2022)	ADV at the Time of COVID-19 Brain Effect between Emotional Engagement and Purchase Intention	fNIRS	To assess whether emotionally charged COVID-19-themed advertisements enhance neural emotional engagement—and whether this translates into explicit purchase intentions	COVID-19-themed commercials led to increased emotional engagement and greater activation in the prefrontal cortex, especially the left dorsolateral PFC
31	Hirabayashi et al. (2024)	Right prefrontal activation associated with deviations from expected lipstick texture assessed with functional near-infrared spectroscopy	fNIRS	To assess the feasibility of a real-time, brain-based method for evaluating products, specifically lipstick, by detecting incongruence between the product and consumer expectations	Higher perceived texture incongruency in lipstick was linked to increased activation in the right inferior frontal gyrus (IFG), suggesting the IFG plays a key role in detecting sensory mismatch

32	Bosshard & Walla (2023)	Sonic Influence on Initially Neutral Brands: Using EEG to Unveil the Secrets of Audio Evaluative Conditioning	EEG (ERPs)	To compare the sensitivity of explicit (self-report) and implicit (IAT and EEG) measures in detecting attitude changes toward brands following evaluative conditioning (EC) with positive and negative audio cues	Self-reported ratings and IAT results showed no significant change in brand attitudes after conditioning. However, EEG detected clear neurophysiological changes, particularly at frontal sites (AF3 and AF4), indicating that EEG is a valuable tool for uncovering implicit attitude shifts not captured by conscious measures
33	Hirabayashi et al. (2021)	A Willingness-to-Pay Associated Right Prefrontal Activation During a Single, Real Use of Lipsticks as Assessed Using Functional Near-Infrared Spectroscopy	fNIRS	To replicate a previous study linking right dorsolateral prefrontal cortex (dlPFC) activity to willingness-to-pay (WTP) during cosmetic use, and to refine the methodology to better detect valuation differences between lipstick products	A significant positive correlation between right dlPFC activity and WTP, replicating earlier findings. However, variations in lipstick color and texture did not lead to consistent differences in WTP or brain activation across participants
34	Russo et al. (2022)	The Role of the Emotional Sequence in the Communication of the Territorial Cheeses: A Neuromarketing Approach	EEG + skin conductance Sensor (GSRSen) + PPG sensor (FpSen)	To determine how distinct emotional sequences (positive–negative vs. negative–positive framing) influence consumer perception and communication effectiveness when presenting territorial cheeses	Commercial with a negative-to-positive emotional sequence elicited stronger emotional engagement and better memory activation than the purely positive one
35	Jing et al. (2022)	The Effectiveness of Price Promotions in Purchasing Affordable Luxury Products: An Event-Related Potential Study	EEG (Event-Related Potentials ERPs)	To investigate how price promotions influence consumer purchase intentions toward affordable luxury products, considering both original (high/low) and current (discounted/non-discounted) price	High-priced affordable luxuries with discounts elicited the strongest purchase intentions. Discounted low-priced items led to faster decisions. ERP data showed reduced N2 (less conflict) and lower LPP (more evaluative consistency) in discounted conditions

36	Shu et al. (2024)	The N270 as an index of consumer commodity color preference in the S1-S2 paradigm	EEG (ERPs: N270)	To investigate whether the N270 ERP component can serve as a neural marker of consumer preference for commodity colors	A significant N270 response in the prefrontal area for both "Like" and "Dislike" conditions, with a stronger amplitude during "Dislike"
37	Wang et al. (2021a)	The Implicit Aesthetic Preference for Mobile Marketing Interface Layout—An ERP Study	EEG (ERPs)	To investigate consumers' implicit aesthetic preferences for different mobile marketing interface layouts	Disliked mobile marketing interfaces elicited distinct brain responses (P2 and LPP components), indicating that people form rapid, implicit aesthetic preferences for interface layouts
38	Levrini & Santos (2021)	The Influence of Price on Purchase Intentions: Comparative Study between Cognitive, Sensory, and Neurophysiological Experiments	EMG + eye-tracking	To explore how consumers perceive retail skincare brands versus premium and popular brands, focusing on how price and quality associations influence purchase decisions	Initial unconscious preferences changed when price and brand were revealed. Price had the strongest influence on purchase intentions
39	Mei et al. (2021)	An Investigation of a Frontal Negative Slow Wave in a Virtual Hedonic Purchase Task	EEG (ERPs: FNSW and N2)	To investigate the neural mechanisms underlying consumer behavior in response to different promotion types (pure price promotion vs. mixed promotion) in hedonic purchases, focusing on impulsive and prudent consumers	Consumers prefer mixed promotions (discount plus charity) despite responding faster to pure price discounts. Impulsive buyers show more brain activity linked to controlling urges. Mixed promotions cause more mental conflict, leading consumers to reject worse deals
40	Šola et al. (2025)	Neuroscientific Analysis of Logo Design: Implications for Luxury Brand Marketing	Eye - tracking + EEG	To evaluate how dynamic and verbal elements in luxury logos affect consumer attention, engagement, emotion, and memory	Dynamic logos with prominent visual elements attract more attention, boost emotional engagement, and improve memory recall compared to static designs
41	Cui et al. (2023)	Emotion recognition based on group	EEG (PLV)	To develop a data processing method to improve emotion	Group-level PLV-based CNN classification achieved

		phase locking value using convolutional neural network		recognition efficiency by analyzing group EEG signals	high accuracy (~83-85%) for arousal and valence recognition, outperforming individual-level analysis
42	Lajante et al. (2020)	Looking at Aesthetic Emotions in Advertising Research Through a Psychophysiological Perspective	EMG + Self-report scales (SAM)	To examines how emotional reactions to commercials—both physical and emotional—shape consumers' attitudes toward ads	Typical commercials mainly trigger aesthetic emotions, with physiological, expressive, and subjective emotional responses all influencing attitudes toward advertising
43	Ausín-Azofra et al. (2021)	Do You See What I See? Effectiveness of 360-Degree vs. 2D Video Ads Using a Neuroscience Approach	EEG + eye-tracking + EDA + facial coding	To compare emotional responses to 360° vs 2D ads	360° ads received less focused visual attention compared to traditional 2D ads, with fewer fixations and less time spent on specific stimuli
44	Kim et al. (2020)	The Impact of Visual Art and High Affective Arousal on Heuristic Decision-Making in Consumers	EEG	To investigate how different abstract art styles (neutral neoplasticism vs. expressive expressionism) on product packaging affect consumers' emotional responses and subsequent decision-making	Exposure to emotionally intense expressionist art (like Kandinsky) led to stronger emotional arousal and faster but less accurate decisions, suggesting that highly emotive packaging may reduce cognitive control and encourage impulsive buying
45	Fu et al. (2022)	How Does the Implicit Awareness of Consumers Influence the Effectiveness of Public Service Announcements ? A Functional Near-Infrared Spectroscopy Study	fNIRS	To investigate whether dlPFC activity measured by fNIRS can predict the effectiveness of public service announcements (PSAs) in influencing behavioral intention	dlPFC (Dorsolateral Prefrontal Cortex) activation correlated positively with PSA effectiveness. Neuroimaging tools can predict PSA impact before release
46	Qing et al. (2021)	Decoding Three Different Preference Levels of Consumers	fNIRS (CNN)	To decode consumers' preference levels for commercial advertisements	A CNN model using fNIRS data accurately classified consumer preferences, reaching 87.9% accuracy for 30-

		Using Convolutional Neural Network: A Functional Near-Infrared Spectroscopy Study			second ads. Performance was consistent across genders (~86%)
47	Najafabadiha et al. (2024)	Fostering consumer engagement in online shopping: Assessment of environmental video messages in driving purchase intentions toward green products	Eye-tracking + questionnaire	To assess how environmental video messages influence consumer engagement and purchase intentions toward green products	Purchase intentions toward green products were positively influenced by the video messages
48	Mauri et al. (2021)	Applying Implicit Association Test Techniques and Facial Expression Analyses in the Comparative Evaluation of Website User Experience	IAT + facial expression analysis	To evaluate whether IAT (BARTT) and facial expression analysis can assess and compare user experience (UX) during and after website navigation	Combining facial emotion analysis and implicit association tests revealed how different web design choices impact user experience (UX)
49	Gier et al. (2020)	Measuring dlPFC Signals to Predict the Success of Merchandising Elements at the Point-of-Sale - A fNIRS Approach	fNIRS	To test whether mobile fNIRS-measured dlPFC activity can predict actual sales success of different point-of-sale (PoS) merchandising elements	Mobile fNIRS measurement of dlPFC activity—specifically reduced activation—can forecast consumer purchase behavior and actual sales success of merchandising elements
50	Tonacci et al. (2023)	Taste the emotions: pilot for a novel, sensors-based approach to emotional analysis during coffee tasting	ECG + EEG + EDA	To evaluate the feasibility of using wearable biomedical sensors (ECG, GSR, EEG) to measure implicit emotional responses during coffee tasting	Significant correlations were found between physiological signals and self-reported data across olfactory, visual, and taste domains, especially for autonomic features
51	Barquero-Pérez et al. (2020)	Autonomic Nervous System and Recall Modeling in	ECG + EDA + questionnaire	To investigate how autonomic nervous system (ANS) responses—measured	The model showed that vagal activity (HRV indices) was the strongest contributor to

		Audiovisual Emotion-Mediated Advertising Using Partial Least Squares-Path Modeling		via heart rate variability (HRV) and electrodermal activity (EDA)—relate to memory recall of emotional advertisements	ANS response. ANS behavior was moderately explained (38–64% variance), but recall scores were weakly predicted (only up to 11%). This suggests that ANS signals have limited power in predicting memorization outcomes
52	Wei et al. (2023)	The Influence of Tourist Attraction Type on Product Price Perception and Neural Mechanism in Tourism Consumption: An ERP Study	EEG (ERPs)	To examine how tourist attraction type (entertainment vs. sightseeing) and price levels affect consumer price perception and decision-making	P2 amplitude increased with price deviations from expected. LPP higher for reasonable price in entertainment attractions vs sightseeing. This demonstrates how price affects consumer decisions
53	Wei et al. (2024)	The influence of message frame and product type on green consumer purchase decisions: An ERPs study	EEG (ERPs)	To examine how message framing (positive vs. negative) and product type (utilitarian green products) affect consumer decision-making and neural responses during green consumption	Positive framing increased early cognitive attention for utilitarian products and negative framing heightened emotional arousal in the later cognitive stage. The influence of message framing on purchase decisions was moderated by product type.
54	Polo et al. (2024)	Understanding the role of emotion in decision making process: using machine learning to analyze physiological responses to visual, auditory, and combined stimulation	ECG + BVP + GSR + pupillometry + EEG + RESP	To investigate autonomic and central nervous system responses to emotional stimuli (images, auditory cues, and their combination) and identify the most effective approach for distinct physiological patterns using machine learning	Auditory stimuli significantly enhance the accuracy of classifying emotional states based on physiological responses, with EEG, GSR, and cardio-respiratory features playing key roles. Combining visual and auditory stimuli improves classification performance
55	Yu et al. (2022)	Strong Displayed Passion and	EEG	To investigate how broadcasters' displayed passion and	Found that Passion strongly boosted viewers' neural

		Preparedness of Broadcaster in Live Streaming E-Commerce Increases Consumers' Neural Engagement		preparedness in live streaming e-commerce influence consumers' neural engagement	engagement, especially when combined with preparedness
56	Yen & Chiang (2021)	Examining the effect of online advertisement cues on human responses using eye-tracking, EEG and MRI	Eye-tracking + EEG + fMRI	To explore how different online advertisement cues influence neural activity during the process of product preference elicitation	Different online advertisement cues distinctly modulate neural activity linked to attention and cognitive processing during product preference decisions
57	Moriya et al. (2024)	Relationships between subjective experience, electroencephalogram, and heart rate variability during a series of cosmetic behavior	EEG + ECG	To explore the relationship between physiological responses, subjective experiences, and the type and price of cosmetic products during different makeup steps	Self-confidence increased and negative emotions decreased with each cosmetic step. Hedonic perception was higher with luxury products
58	Duan et al. (2021)	Gender Differences in Transnational Brand Purchase Decision Toward Mixed Culture and Original Culture Advertisements: An fNIRS Study	fNIRS	To investigate gender-specific neural and behavioral differences in purchase decisions for transnational brands using original-culture vs. mixed-culture ads	Females showed significantly higher purchase rates for original-culture ads compared to mixed-culture; males showed no preferenc
59	Wang et al. (2021b)	The Effect of Product Image Dynamism on Purchase Intention for Online Aquatic Product Shopping: An EEG Study	EEG (ERPs : N2, LPP)	To examine how perceived dynamism (static vs. dynamic images) of aquatic product pictures (fresh vs frozen) affects purchase intention	Dynamic images increased purchase intention, reduced N2, increased LPP. Suggests retailers should use dynamic-style imagery for online aquatic products, especially fresh ones

Appendix 2: Arabic abstract

ما وراء التقارير الذاتية: مراجعة منهجية لأساليب التسويق العصبي في استكشاف سلوك المستهلك

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ملخص

أصبح فهم سلوك المستهلك على مستوى أعمق وأكثر موضوعية أمرًا ضروريًا في ظل التغيرات السريعة التي يشهدها علم التسويق اليوم. غالبًا ما تتجاهل الأساليب التقليدية، مثل الاستطلاعات والمقابلات، تفاعل العمليات العاطفية والتحليلية في صنع القرار. وحيث ان خياراتنا تتشكل من خلال ردود الفعل السريعة والحدسية من جهة والتفكير الأبطأ والأكثر عقلانية من جهة اخرى. وبالتالي، فإن ربط التسويق وعلم الأعصاب من خلال التسويق العصبي يوفر حلولاً لاستكشاف كيفية تفاعل هذين النمطين من التفكير، باستخدام أدوات متقدمة تكشف عن كيفية استجابة المستهلكين لمحفزات التسويق.

تقدم هذه الأطروحة مراجعة منهجية للأدبيات (SLR) حول تطوير التسويق العصبي وتطبيقه العملي كأداة لفهم سلوك المستهلك. باستخدام عملية مراجعة منظمة، تم تحديد وتحليل 59 مقالة تمت مراجعتها من قِبل الأقران من PubMed و EBSCOhost . حيث تم تضمين المقالات المنشورة باللغة الإنجليزية فقط، بينما تم استبعاد الافتتاحيات والمراجعات المنهجية الأخرى للأدبيات للحفاظ على التركيز على اهداف البحث. تم اختيار هذه الدراسات بناءً على دقتها المنهجية، وأهميتها، وتوافقها مع أهداف الدراسة، مما يضمن الحصول على نتائج شاملة وموثوقة.

حددت المراجعة سبعة مواضيع متكررة في الأدبيات: التنبؤ بتفضيلات المستهلك، وإدراك العلامة التجارية، وفعالية الإعلان، وتضارب اتخاذ القرارات، والانتباه البصري، وتأطير الرسائل، والواجهة/التجارة الإلكترونية. برزت هذه المواضيع من خلال تحليل كيفية تطبيق أدوات مثل تخطيط كهربية الدماغ، والرنين المغناطيسي الوظيفي، والتحليل الطيفي بالأشعة تحت الحمراء القريبة (fNIRS)، وتتبع حركة العين لتقييم الانتباه، والتفاعل العاطفي، وعمليات اتخاذ القرار البديهية والمتعمدة. توفر هذه الأدوات مجتمعةً رؤى آنية أغنى من التقارير الذاتية، مما يعزز القدرة التنبؤية لاستراتيجيات التسويق.

تشير النتائج أيضًا إلى اعتبارات منهجية مهمة في أبحاث التسويق العصبي، ولا سيما الحاجة إلى تحديث الأطر الأخلاقية والتنظيمية. وتشمل الاهتمامات الرئيسية حماية خصوصية المستهلك، وضمان الموافقة المستنيرة، وإدارة البيانات الحساسة بمسؤولية. وينبغي للمؤسسات العامة والهيئات التنظيمية التعاون مع الأكاديميين وخبراء الصناعة لوضع معايير تعزز الاستخدام المسؤول لعلم الأعصاب في أبحاث التسويق. وبالتوازي مع ذلك، يمكن لسياسات التعليم العالي والابتكار دمج التسويق العصبي في المناهج الدراسية متعددة التخصصات وبرامج ريادة الأعمال، مما يزود المهنيين في المستقبل بالقدرة على تطبيق هذه الأدوات بدقة منهجية ومسؤولية أخلاقية.

الكلمات المفتاحية: التسويق العصبي، التخطيط الكهربائي للدماغ، سلوك المستهلك، اتخاذ القرار الشرائي.