


Entry

Unveiling Neuromarketing and Its Research Methodology

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Definition: Neuromarketing is the union of cognitive psychology, which studies mental processes, neurology and neurophysiology, which study the functioning and responses of the brain and body physiology to external stimuli, and marketing, which studies valuable exchanges, to explain marketing effects on customers' and consumers' behaviours and on buying and decision processes. It includes a set of research techniques that, by observing and evaluating how the brain and other body parts respond, avoids possible biases and provides truthful and objective information on consumer subconscious. The term "consumer neuroscience" covers academic approaches using techniques such as fMRI, Eye Tracking, or EED. The objectives of this entry are to show what neuromarketing is and what added value it brings to the study of consumer behaviour and purchase decision processes. The conclusions show a favourable future and positive attitudes towards neuromarketing.

Keywords: neuromarketing; techniques; metrics; market research; add value; uses and attitudes; academic research; consumer neuroscience



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1. Introduction

After the turn of the millennium, marketing theorists and practitioners were confronted with the situation that the needs of consumers, and accordingly of advertisers, had changed with the spread of the Internet. Brand owners, i.e., advertisers, expect more accurate results from market researchers, and consumers have become more advertising-avoidant, making it much more difficult to reach them with advertiser messages [1–3]. In addition to more accurate data, there is a need to understand, explain, and, above all, predict the behaviour of individuals, groups, and firms toward relevant markets [4]. This type of prediction is becoming more accurate using available technological tools [5].

All of this has had a logical impact on market research practice: with the rapid development of technology, software and applications have become available and more widely used to explore consumers' needs more closely than hitherto [6,7]. This trend has given rise to a research method called neuromarketing.

Neuromarketing is a market or academic research technique that is based on the use of neuroscientific techniques to adapt them to marketing and thus try to understand the purchasing processes of consumers, trying to reach the unconscious and subconscious parts of them. The information provided by these types of techniques is very valuable and, on certain occasions, unattainable with other traditional research techniques. However, despite the undeniable added value that neuromarketing provides, its full acceptance by professionals and academicians is doubtful.

The techniques and methodologies used in market and academic research are constantly evolving, and neuromarketing is a clear reflection of this. This new technique has made it possible to answer questions that, until now, marketing researchers were not able to fully explain—why do you buy a certain product and not another, why you like one brand more than another, why do you pick up a brand in the retailer's shop and not another, why

does a commercial create a more intense emotional response towards the brand than another, etc.—and, ultimately, it has allowed understanding the functioning of the consumer’s subconscious and its influence on consumer behaviour and purchasing processes.

2. Defining Neuromarketing

In marketing literature, the terms consumer neuroscience and neuromarketing have been used systematically, even as interchangeable or synonymous terms. Regardless of its lexical and semantical use, these are pragmatically different for some authors. Consumer neuroscience is understood as academic research that combines neuroscience, psychology, and biology to explain contextually situated human behaviours, such as consumption or voting behaviours, and neuromarketing is understood in a more practical and business way as a set of neurophysiological tools used by market research companies or practitioners [8]. In the same vein, Nemorin (2018, p. 56) understands “neuromarketing as a commercialised market research method for studying brain activity that combines the methodologies of cognitive neuroscience and behavioural psychology to generate a greater understanding of how consumers respond to products, brands and advertising stimuli” [9]. However, for other authors, neuromarketing goes beyond tools and their use in market and marketing research.

Lee et al. [4] stated that neuromarketing is the application of neuroscience methods to the analysis of consumers to understand their behaviour in relation to markets and their exchanges. Ultimately, it is about applying neuroscience to marketing to explain the effect of marketing on consumers or customers, consumer behaviour, or purchasing processes. It can be said that neuroscience is the set of sciences that, from various points of view, study the nervous system and allow access to physiological and mental phenomena that occur in the brain of the individual, i.e., the reaction of the brain to advertisements and commercials, logos, packaging, shapes, brands in the shop, images, prices, web pages, and so on. Marketing, for its part, is the set of techniques and studies that aim to commercialize a product. It is, therefore, the union of both neuroscience and marketing to understand the minds of consumers in the purchase process, leaving aside the rational and conscious parts of them.

According to Braidot [10], neuromarketing can be defined as a kind of science that tries to investigate and analyse certain brain processes to explain the way of acting and the decision-making process of the individuals in the traditional marketing arena. Additionally, this discipline applies knowledge from multiple areas of study, such as molecular biology, electrophysiology, neurophysiology, anatomy, embryology, developmental biology, cell biology, behavioural biology, neurology, cognitive neuropsychology, and cognitive sciences [10]. Naranjo [11] stated that neuromarketing allows determining the reaction and brain activity produced by stimuli from marketing elements using different medical technology techniques. Indeed, as Baptista, León, and Mora [12] explained, by understanding how the nervous system works and deepening the way in which the consumer perceives the different stimuli, their needs can be recognized more clearly and precisely, which will consequently contribute to obtaining, differentiating, and generating valuable information. Likewise, Dooley [13] defined neuromarketing as a way to understand how the brain works, regardless of the technique used, using the information provided by this complex organ to improve products and, ultimately, all the variables of marketing.

In the opinion of Lindstrom [14], neuromarketing is not only the union between marketing and neuroscience, but is also the key to understanding the subconscious reasoning, feelings, and desires that drive us when making a purchase. In this sense, 85–90% of purchase decisions are made unconsciously, and 60% of what we buy is decided in less than 4 s [14]. In the same vein, Johansson [15], after conducting an experiment on choice blindness, affirmed that we justify our decisions post-purchasing. In addition, it has been proven that subjects are not capable of revealing the reason for their behaviour or the reason for certain decisions and preferences [16]. The mind and the brain are indivisible, and decisions are made mostly in the subconscious based on experience and emotions [17].

Zurawicki [18] described neuromarketing as a tremendously complex study of consumers' perception, learning, memory, and feelings in the context of practically the entire consumer journey, where they acquire and use products and services. To attain a better understanding of how these consumers make choices and decide to buy, enhanced knowledge of their experience of the consumption is paramount. The utilization of the findings of neuroscience, so-called neuromarketing, could provide invaluable insights by selectively addressing a diverse range of issues in consumer behaviour research. Zurawicki also noted that "due to the varying complexity of the research tasks, constraints imposed by the available technology and the difficulty in staging different types of experiments" (2010, p. 55), the design of neuromarketing research could be challenging.

Finally, both the technology used and the methods of analysing brain activity and its meaning are constantly evolving [4]. In short, neuromarketing aims to analyse the emotional impact caused by a certain product, service, advertisement, brand, or any other stimulus, and understand and even anticipate consumer behaviour at the time of purchase so that the customer's wants can be met. All this without asking the individual any questions, but through the information provided by the subconscious, emotional, and non-rational parts of the brain as responses to marketing stimulus. Some definitions of neuromarketing can be seen in Table 1.

Table 1. Definitions of neuromarketing.

Authors	Definition
Braidot (2006)	A kind of science that tries to investigate and analyse certain brain processes to explain the way of acting and the decision-making process of individuals in the traditional marketing arena
Lee, Broderick and Chamberlain (2007)	As a sub-area of neuroeconomics, it is the application of neuroscientific methods to analyse and understand human behaviour in relation to markets and marketing exchanges
Lindstrom (2012)	The union between marketing and science, as a technique to understand the logic for people's purchases, and analysing the subconscious thoughts, feelings, and desires that move our decisions when making a purchase decision.
Braidot (2011)	An advanced discipline that examines the brain processes that explain behaviour and decision-making behaviour by people in the fields of action of traditional marketing: market intelligence, product and service design, communications, pricing, branding, positioning, targeting, channels, and sales.
Zurawicki (2010)	A complex study of consumers' perception, learning, memory, and feelings in the context of practically the entire consumer journey, where they acquire and use products and services.
NMSBA n.d.	Neuromarketing uses neuroscience to reveal subconscious consumer decision-making processes. Neuromarketers study brain and biometric responses, as well as behaviour, to understand and shape how consumers feel, think, and act.
Royo-Vela and Varga	It is the union of cognitive psychology, which studies mental processes, neurology and neurophysiology, which studies the functioning and responses of the brain and body physiology to external stimuli, and marketing, which studies valuable exchanges, to explain marketing effects on customers and consumers behaviour and on buying and decision processes.

3. A Short History of Neuromarketing

Originally, the first research attempts that were carried out to try to understand the decision-making process of consumers completely neglected the emotional component,

which was considered, indeed, an inconvenience or obstacle to decision-making that was thought to be solely based on rational processes. It was at the end of the 1970s when important studies began to be carried out that highlighted the importance of human emotions and their influence on decision-making [19].

Tversky and Kahneman [20] challenged the orthodox economic theory assumption that individual rationality drives economic behaviour. These authors claimed that the classical homo economicus violates systematically his/her economic rationality, and that decision-making is far from being wholly rational and unbiased (by emotions). Later elaborations in behavioural psychology and behavioural economics have proposed the dual-process model or the existence of two independent decision-making systems in the individuals' brain. According to Kahneman [21], the dual system model is a conceptual framework to explain brain processes in which reasons, emotions, and instincts are involved in decision-making. The two systems describe different cognitive processes to make economic decisions. The first cognitive process is fast, automatic, reactive, limbic/reptilian, emotional, and not controlled by the individual. This process results in intuitive judgements and decisions. The second is slow, analytical, cautious, and under the individual's control. The latter results in judgements and decisions based on facts and reasons [21].

The dual system model can be complemented by Damasio's thought [22], who better explained how economic choice occurs. According to Damasio, emotions are not only intertwined with reasons and feelings, but also play an important role in decision-making, since decision-makers can be intuitive, affective, or emotional, rather than rational, in their decisions. The second cognitive process, or the rational brain, the frontal cortex, plays a role in long-term economic rewards. However, in the case of impulsive, compulsory buying behaviour or short-term economic rewards, the first cognitive process works and decisions are made in an intuitive and emotional way. Damasio [22] found the relevance of emotions in the decision-making process and how to measure them, and determined that there was an intensive unconscious component in explaining human behaviour.

We can place the origin of neuromarketing around the 1990s, when progress in neuroscience ended with the idea, similar to psychology, economics, or business, that a human being is one-hundred percent rational and fully aware of their decisions [23]. Neuroscience advances have made it possible to observe the functioning of the human brain more precisely and its response to environmental stimuli, and this new knowledge has been grasped by marketing and consumer researchers. Therefore, it was in these years when marketers and scientists joined their knowledge in order to carry out joint research, adapting the technology used by neuroscientists and biometrics and applying it to market and marketing research; in the past, some outstanding discoveries and technological developments contributed to the development of techniques currently applied in neuromarketing research. Among them, we can highlight the following: in 1849, Emil du Bois-Reymond, a German physician and psychologist, observed for the first time that human skin is electrically active; in 1889 Ivane Tarkhnishvili, a Russian psychologist, developed a device to measure the electrical activity of the skin; as early as 1901, Willem Einthoven developed the first device to measure cardiac activity, and in 1924, Hans Berger recorded the first electroencephalography measurement. It was in the 1930s that the first non-invasive eye-tracking meter was developed, although it was not until the 1970s that its use as a research method became popular and Paul Ekman delved into his studies of non-verbal communication, focusing on facial expressions [24]. Large multinationals, such as Coca-Cola, Ford, and Levi-Strauss, were the first to adopt this type of research [24].

The term "neuromarketing" was used for the first time in 2002 when Smidts [25] coined it to describe and explain the application of neuroscientific techniques to the field of marketing. In 2003, the first academic study on the subject was published, called "Neural correlates of behavioural preference for culturally familiar drinks" [26]. This was an experiment carried out by the American neuroscientist Read Montague [27] in which several subjects underwent functional magnetic resonance imaging (fMRI) tests. In the first stage of the investigation, the subjects tried the Coca-Cola and Pepsi soft drinks in

crystal glasses, and the result was that more than 50% of the sample chose the Pepsi flavour over that of Coca-Cola. However, in the second part of the experiment, the participants were shown the brand of the drink before they tried it, and, surprisingly, 75% of them chose Coca-Cola. Furthermore, an additional change in brain activity could be perceived at the time of choice, since the inner prefrontal cortex was activated. With these data, Montague was able to conclude that there was a certain struggle between the rational part and the emotional part of the brain, that there was a small moment of indecision, and that, finally, the emotional part (in this case, Coca-Cola) dominated the rational part (in this case, Pepsi). By 2005, neuroscience and marketing were related in the Marketing Research Society (Market Research Society (MRS) (2005). Conferences. MRS.org.uk. Retrieved from <http://bit.ly/1qdACpQ>, accessed on 17 March 2022) and the ESOMAR conferences, where papers and conferences on neuromarketing made their appearance. Three years later, in 2008, the Journal of Consumer Behaviour published a special issue on neuromarketing.

Plassmann et al. [28] claimed that price could act as a placebo and that it could arouse positive expectations of quality, and demonstrated this through a study carried out in 2008, in which several subjects were placed with a brain scan and asked to taste wine. During one part of the experiment, they offered users the same wine twice without their knowing it, warning them on one occasion that it was a wine that cost approximately \$10 and, on the other occasion, that it was a wine with a price of around \$90. Surprisingly, when users drank the supposedly more expensive wine, it increased the activity of their reward system in the orbitofrontal cortex.

It should be noted that the neuromarketing boom was not without criticism and controversy, as a certain fear was created that the minds of consumers could be controlled and the way in which the discoveries obtained with this type of research could be used was questioned (see later). In this line and partly giving coverage to these concerns, in 2005, the Covington White Paper offered an overview of the legal and political issues that neuromarketing posed for the advertising industry [29]. Despite this, neuromarketing was consolidating and nothing prevented further research on the subject, so articles and books began to be published. Thus, as of 2010, it was possible to significantly reduce the size of the devices that were used, which encouraged the discipline to experience its maximum splendour [24].

In 2012, the Neuromarketing Business and Science Association (NMSBA) was created with the goal to improve the methodology as well as the intention to achieve greater acceptance of neuromarketing. It is a global association that brings together all those who have a professional interest in the matter. In that same year, the NMSBA held the first Neuromarketing World Forum [30] and published the first issue of the Neuromarketing Theory and Practice magazine [9]. Its 10th edition will be held in Berlin in 2022, and, nowadays, the association also publishes a quarterly magazine called Insights [30]. In 2014, the NMSBA published the Code of Ethics—deontological code—for the application of neuroscience in business. The Grit Report studied the evolution of the use of different techniques that can be applied to market research, including neuroscience. In 2014, the percentage of use of neuroscience techniques was 13% and in 2019 it was 29%, experiencing an increase of 16 percentage points in five years. In addition, compared to the other techniques evaluated, they also experienced the greatest increase in their use during this period of time [31].

Finally, neuromarketing is a discipline that is continually changing, advancing, and adapting to technological reality. Thus, the use of neuromarketing techniques has been proposed together with Virtual Reality, Artificial Intelligence, and Big Data. Therefore, it must be emphasized that technology in the field of Mixed and Virtual Reality has recently been developed and improved, which opens an ambitious field that has not yet been explored and is promising and favourable for its use together with neuromarketing [32–34]. Mixed Reality is a novel technological method that enables virtual content to be introduced into the subject's real world so that it works in the same representation and in real-time [35].

4. Research Techniques Used in Neuromarketing

As neuromarketing, a novel research field, started to become widespread, a certain demand was articulated to gain a clear understanding of its applied methods by classifying the diagnostic tools, techniques, and approaches. Bercea [36] divided the applied neuromarketing tools into three subcategories based on their ability to record different brain- or neural activity-related signals based on the works of Calvert and Thensen [37], Kenning and Plassmann [38], and Zurawicki [18].

The first category consists of tools that record the metabolic activity of the brain, such as functional magnetic resonance imaging (fMRI), magnetoencephalography (MEG) or Positron emission tomography (PET).

fMRI, as the improved version of MRI, examines two phenomena: one is that the blood contains iron, which plays a role in oxygen transport. Iron particles that do not currently deliver oxygen cause a slight “disturbance” in the magnetic field around them. The other phenomenon is the property of the brain that the blood vessels in the area of increased activity dilate, thereby delivering more blood to the area. In short, we do not see direct neurological activity, but the hemodynamic response of the brain. This phenomenon is called the BOLD (blood-oxygen-level-dependent) signal, which is often used as a dependent variable in neuromarketing research [39]. The use of fMRI is necessary to obtain information on the activity of the most internal parts of the brain, such as the Nucleus Acumbens, which has been linked to purchase intention; the Insula, which is related to the intensity of liking or disliking what is being seen; the Ventromedial Prefrontal Cortex (VMPFC), which seems to be involved in post-brand decision processes; or the Anterior Cingulate Cortex (ACC), which allows measuring the degree of perceived contradiction between stimuli [40]. Magnetoencephalography (MEG) is a high-quality technique, but rare in practice due to its high economic cost [41]. It tries to measure the magnetic fields produced by neuronal activity in the brain in the face of certain stimuli, allowing the investigation of the relationships between brain structures and their functions [42]. Positron emission tomography (PET) is a rare technique since it is highly invasive for the subject. It is a study model using images that measures changes in the brain’s metabolism relative to its glucose from an injection that is administered to the individual studied [43].

The second group includes devices that measure the electrical activity of the brain, the most widely used of which is the electroencephalograph, i.e., the EEG [44,45]. It is one of the most used techniques in neuromarketing since its cost is not excessively high and its use allows the subject, unlike the fMRI, certain mobility [35]. Brain cells communicate by means of electrical impulses and are always active. This activity is expressed as wavy lines in an EEG recording ([32], see [46] for an application). It can be stated that measuring brain waves has a long history. Different amplitudes indicate different states, such as wakefulness (beta waves), resting state (alpha waves), rest (theta waves), waking, and deep sleep (delta waves). For more accurate measurement, several electrodes (up to more than 200) are placed on different areas of the skull and the scalp (see text box below). The interpretation of the data requires the establishment of a “baseline,” and the data obtained are evaluated by the researchers based on the deviation from this. In short, through visual and auditory stimuli, the changes in the electrical impulses of the central neurons are studied so that the different parts of the cerebral cortex that are activated with each stimulus can be observed. This technology is very useful to know the level of attention, engagement, memorization, and emotional valence of an individual [47]. In addition, this technique is especially suitable for measuring the reaction of a subject to an advertisement, since neurons generate an electric current that can be amplified and, through brain waves, different states of excitement can be associated [48]. Portable EEG devices allow real-time measurement of consumer reactions in a real-world environment: they are convenient and do not interfere with subjects in their normal activities. The disadvantage is that the data from individual subjects are difficult to compare due to the varying electrical activity from person to person. Because different tissues have different conductivities, in many cases, it is difficult to identify exactly which area of the brain a given electrical emission originates from.

The third group of tools do not directly record brain activity, but they are still related to neural activities. These are physiological techniques, that is, those that, despite not being exactly neuroscientific, are also used to evaluate the psychophysiological responses of users. These measures study and try to understand the reactions of the individual by examining and analysing body signals. The more used, often complementarily, measures are eye-tracking, Galvanic Skin Response (GSR), heart rate, electromyography, wearables, or implicit associations test.

- Wet electrodes are electrodes generally made of silver/silver chloride material (Ag/AgCl). They use an electrolytic gel material as a conductor between the skin and the electrode. In these electrodes, the impedance present between the electrode and the skin is directly related to the performance of the electrode. Therefore, using active electrodes is helpful since it stabilizes the performance of the electrode, reducing the dependence on the conductive gel. In addition, they also showed less error (voltage difference) between the reference signal and the measurement taken with the electrodes.
- Dry electrodes consist of a single metal (i.e., stainless steel) that acts as a conductor between the skin and the electrode. For the application of dry electrodes, it is necessary to apply the gel to each electrode. If the electrode is in a sensitive area, it can irritate the area (i.e., near the eyes). A LiveCap with 64 active channels involves the application of the gel to 64 electrodes. If it is used for extended periods of time, the gel can lose its water, so re-application and the interruption of signal monitoring may be necessary. In addition, the removal of the electrodes requires a little more time for cleaning the electrodes, as well as the skin where they were placed. Finally, although cases are rare, they can cause dermatitis. Related to wet electrodes, higher noise levels are obtained. Additionally, there are differences between the values measured with these electrodes and the reference values. It is possible that these levels of error, unlike wet electrodes, are due to the absence of an electrolytic layer. Nevertheless, if the electrodes are properly positioned with firm contact between the skin and the electrode, reliable levels of spectral EEG can be measured with or without pre-amplification. In addition, with the dry electrodes, it is possible to carry out the experiments in a real-world environment, outdoors, and not only in inside settings.
- The active electrodes have a pre-amplification module immediately after the conductive material between the skin and the electrode. This allows the signal to be amplified before additional noise is added between the electrode and the system that would capture, process, or amplify the signal. It is recommended to use active electrodes in case the individual is in motion, since the movements can generate deformations in the signal, and when working in areas with considerable electromagnetic noise in the environment, or if the distance between the electrode and the system of capture, processing, or amplification of the signal. These electrodes are more expensive and heavier than passive electrodes.
- Passive electrodes do not have a pre-amplification module. Instead, they simply extend the connection from the conductive material to the equipment for capturing, processing, or amplifying the signal. The speed of changes in voltage during measurement with passive electrodes can significantly influence the amount of noise introduced into the signal.

To place electrodes on human skulls, the international 10–20 electrode placement system can be used (see Figure 1). It ensures that the electrodes are placed on the same areas of the head in all individuals in the experiment (see Figure 1 below).

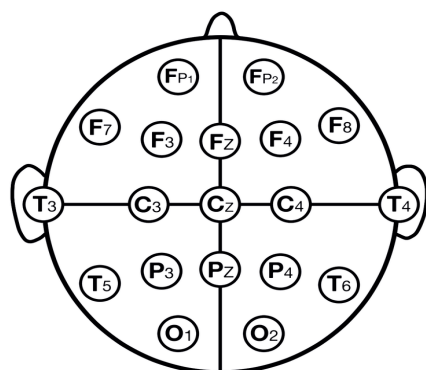


Figure 1. International 10–20 electrode placement system.

The nomenclature uses uppercase letters and numerical subscripts. The frontal, central, temporal, parietal, and occipital electrodes are recognized with the characters F, C, T, P, and O, respectively. Even subscripts indicate the right hemisphere, while the odd ones indicate the left hemisphere [27]. Types and number of electrodes. Source: adapted from Wet, dry, active and passive electrodes. What are they, and what to choose? (brainlatam.com, accessed on 17 March 2022).

Eye-tracking is a technology that makes it possible to record and monitor what the consumer sees when they fix their gaze on an image, video, or a store [49], as well as to know where attention is directed. It is a particularly suitable technique for examining reactions to graphic advertisements, packaging, labels, logos, the web, and PPA [48]. This technique applies various synchronized sensors that perceive the activity and size of the pupil and translate the behaviour patterns of the individual. The measurement of attention and visual exploration that this technique facilitates allows improving the experiences of the subject, providing truthful information regarding eye fixation and eye movements. To make use of this technique, two types of devices can be used: on the one hand, mobile eye-tracking, which is a kind of glasses that provides information about the direction the user is looking in a certain environment (for example, a store or retailer outlet, bank office, or touristic destination). On the other hand, fixed eye-tracking can be used, which involves screen bars that monitor the individual's visual activity on tablets, computers, mobile devices, etc. [47]. The Galvanic skin response (GSR) analyses the secretion of sweat by the sweat glands of the skin, especially in the hands and fingers, which is known as perspiration [43]. This is a technique that is used as a complement to others, since it only offers information about the valence of an emotion, but does not indicate whether it is positive or negative, so it serves to perceive if a response is presented on the skin in front of a stimulus [41]. The heart rate evaluates the heart rate, the speed, and the depth of breathing, since both the speed of the heartbeat and the speed of respiration decrease when attention is increased, but increase when aroused by a stimulus [43]. Electromyography (EMG) measures and studies the electrical activity that is produced by the muscles through electrodes applied by means of needles in the muscle area in question. It is used to record micro facial expressions that are associated with emotional states and thus determine if the user likes or dislikes a certain stimulus [41]. Wearables are portable instruments that immerse themselves in the normal activity of the user in order to measure what the subject feels outside the laboratory, in their routine. They are not invasive at all and incorporate wireless technology to connect devices without wiring. They measure the physiological responses experienced in various situations [41] (see Table 2).

The implicit associations test (IAT) [50] is a part of a psychological-based approach to neuromarketing. The advantages of the implicit methodology are that the distorting effects of completing self-reported (explicit) tests can be eliminated (where the respondent gives a perceptibly expected response instead of the real opinion) and can be demonstrated based on consciously unarticulated preference, and basic behaviour of our attitudes and actions [51]. According to the international literature, the use of implicit measurements is

more like a complement to, rather than a substitute for, traditional market research methods, increasing the depth of knowledge gained through parallel data collection [4,52–54].

The reliability of the aforementioned techniques comes from parallel forms of reliability, which means that multiple methods are applied to examine the same phenomenon. Neuromarketing, by nature, uses this approach, as it usually combines traditional (survey) and biometrics-based methods, or even varies the applied diagnostic tools. The internal consistency reliability is also secured by using multiple tools and examining if they correspond to each other. Cronbach alpha is also widely used to confirm the internal consistency of the survey questions in any neuromarketing research.

5. Neuromarketing and Other Market Research Techniques: The Added Value of Neuromarketing

A common argument in favour of using neuromarketing is that it allows companies to analyse and thus better understand consumer responses to campaigns related to specific brands or products. In a broader sense, the study and explanation of neuroeconomics as an economically relevant behaviour uses methods from the neurosciences. The analysis of the brain and nervous system contributes to the study of consumer behaviour in two ways: through the tools of cognitive and affective neuroscience, it provides an opportunity to study the direct, subconscious responses to different marketing stimuli—this is called methodological application. The other way is theoretical application, in which we can better understand the patterns of consumer behaviour by using deeper insights gained through the study of the brain and psychophysiological responses.

If we take just one step back, we can state that the main objective of market research is to obtain market information through a structured process that can support commercial decision-making. In addition, it specifies the information required to guide marketing actions, design the information collection method, direct and implement the data collection process, analyse the results, and communicate the findings and their implications [48].

While traditional, earlier methods of researching consumer behaviour (qualitative and quantitative methods, such as focus groups, in-depth interviews, projective techniques, surveys, observation, and experimentation) are used to measure consciously articulated responses, neuromarketing undertakes the examination of the subconscious underlying decisions using technological tools [4,18,53]. The study of subconscious decision-making processes in marketing is based on three basic tenets, namely:

- a. Our decisions are greatly influenced by the subconscious, so we cannot provide a satisfactory explanation for the reasons behind each decision.
- b. Our emotions significantly affect our judgment and choices.
- c. Most decisions are not made in full possession of the information, but rather based on partial information, mostly immediately.

Traditional methods and neuromarketing are consistent in several respects. Although some have suggested relegating traditional methods [18], this is not the case: for example, self-reported tests provide this type of research with essential data for the market researcher, but their effectiveness can be increased in neuromarketing research using methods to provide deeper knowledge. However, only a carefully prepared research plan can provide a basis for achieving all of it. Neuromarketing includes a set of techniques that, unlike traditional techniques, obtains valuable information about the consumer without asking any questions, but by observing and evaluating how their brain and other body parts respond. In this way, it analyses brain and physiological processes to evaluate and predict consumer behaviour and thus be able to understand the impact that marketing has on the individual and their thinking. In particular, it tries to understand the wants of the consumer to predict their behaviour in the purchase decision process, as well as to analyse the emotional impact caused by some elements of the purchase, such as the product, the brand, or an advertisement [43,49].

On one hand is the point of view of neuromarketing advocates, knowing how the nervous system works provides especially valuable insights for understanding consumer

emotions. In this sense, traditional market research techniques find a certain limit, since they try to explain consumption habits, the reaction of individuals to certain advertising stimuli, and, ultimately, they try to collect information about the conscious reality of consumers [12]. Along the same lines, González [24] affirms that around 49% of the products that go on the market fail, and traditional techniques, such as in-depth interviews, focus groups, and surveys, using preference questionnaires are unable to mitigate it. In addition, studying the impact of a product on the market only by asking direct questions implies that the results are inevitably biased by the individual’s conscious and rational thought. On the other hand, are the defenders of the classical and traditional market research techniques that leave little room for neuromarketing to act. In this line, researchers defend the value of surveys and focus groups and the unique value of surveys as an explanatory tool is pointed out, leaving neuromarketing as a complement and in no case as a substitute for surveys. Likewise, Álvarez, Mazzitelli, and Tristezza [55] accepted that neuromarketing techniques could be a useful and valuable tool for companies and for future developments, but they agree that it is still a recent and underdeveloped discipline that often causes scepticism and controversy. In addition, they consider that these techniques could in no case become a substitute for the traditional ones, but only a complement to them.

Zaltman [56] affirmed that 85% of any decision is made unconsciously and, in this sense, neuromarketing is the one that deals with studying the unconscious part of the decision-making process, which cannot be carried out by any other research method. As can be seen in Figure 2, the scope of action of the different market research techniques on the conscious and unconscious side is different. Thus, by combining neuromarketing with observation, interviews, group techniques, or surveys, a much broader and more complete view of the consumer’s mental processes can be measured and analysed.

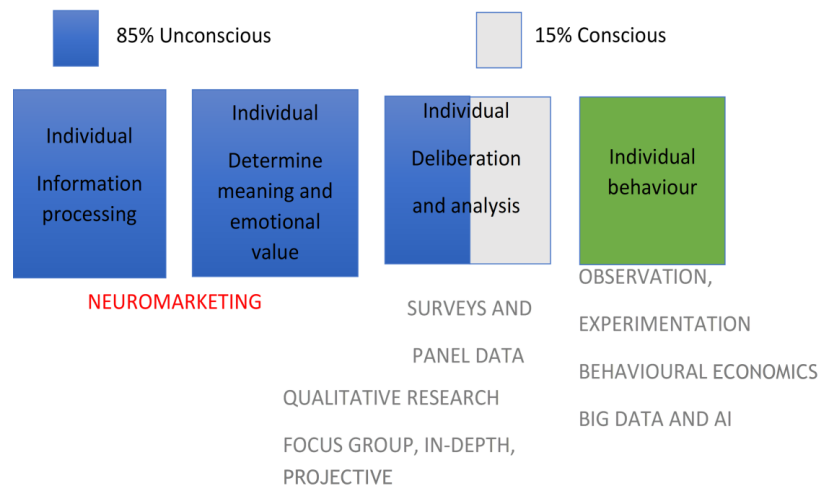


Figure 2. Research techniques and mental process involved. Source: adapted from [49].

In addition, these techniques allow us to find out the levels of attention of the subjects before an advertising spot, as well as to measure the activation of the individual and their emotional state when a certain product appears on the screen [48]. That is why neuromarketing can help to locate key resources, measure different creative possibilities in the realization of an advertisement, and select the versions that are most effective [57]. Therefore, it is used to improve advertising content, copy, length, and media planning, and check if it communicates what the brand wants. Second, neuromarketing can be very helpful in determining whether prices are adequate. By analysing brain activity, it can be seen whether there are regions of pain or happiness when activated. With this, it is possible to check if consumers are willing or not to pay a certain price so that sellers could adjust to it [58]. Likewise, it can be used to analyse the psychological effects of the numbers that form the price or the link between the price and the type of product [59]. In fact, research has been carried out in this regard, concluding that prices ending in 0.99 instead of in whole

numbers cause a certain deception in the consumer's mind, which perceives the former as significantly cheaper (Bizer and Schindler, 2005). In addition, it has been proven that, when the consumer observes the price of the product they want to buy and it is affordable and within their possibilities, the middle prefrontal cortex is activated in their brain, which is responsible for controlling purchase impulses. On the contrary, when the price is outside the range that the consumer is willing to pay, the insula area of the brain is activated, which is in charge of acting when a situation is unpleasant, generating a kind of sensation of pain, so it is likely that the decision not to buy the product is made [60].

Regarding the point of sale, neuromarketing techniques make it possible to analyse the consumer's complete shopping experience in the shop [38]. Although EEG and fMRI are also used, one of the especially relevant techniques in this area is eye-tracking, which enables its use both in real stores and online and allows knowing the best location for a brand in it [57], what (physical or virtual) shopping environment to use, or the best package [61,62]. With regard to the brand, neuromarketing can be very useful for precisely choosing certain elements of the brand to achieve adequate positioning. In addition, with the appropriate techniques, it is possible to know which areas of the brain are activated when products of certain brands are presented and how the perception of the brand influences the purchasing processes [57,63]. In the same way, the response speed of the brain when subjected to the association of a brand with a character that represents it could be analysed [58]. Likewise, it must be emphasized that the design of new products has traditionally been based on the preferences expressed by potential customers without considering the subconscious side of individuals [59]. However, neuromarketing enables the analysis of the brain's responses to the subject's interaction with a product, in such a way that it allows knowing the multisensory perception that is caused during the first moment of contact with the package, unpackaging of the product, perceiving the product, as well as the subsequent perception when it is consuming [48].

In the same way, neuromarketing techniques can also be applied to new technologies and, specifically, to the experience of online users by studying the brain's reaction when it is exposed to stimuli that reach it through the Internet so that it allows understanding how online content, i.e., web sites, app, games, and UGC, affects consumer behaviour in a more objective way [60,64]. Consequently, it makes it possible, among other things, to adapt the design of web pages and online advertising, the design of advergames and games, and the use of social networks or mobile phones for commercial purposes in an appropriate way [48]. Lee, Broderick, and Chamberlain [4] proposed the possibility of using neuromarketing to measure, analyse, and improve customer trust, which is essential to achieving customer loyalty and the creation of a lasting relationship with the brand. According to these authors, it is important to understand neural activity to observe if the level of trust evolves over time, if loyalty occurs towards a specific brand, or to understand its nature.

Recently, various studies have been carried out in which neuromarketing techniques are applied to different specific sectors. One of them is the music sector, in which it is possible to predict whether a certain musical theme will succeed or if, on the contrary, it will fail. Indeed, in a study carried out by the neuroeconomist Gregory Berns, it was discovered that, when a listener likes the song or the sound they are listening to, the nucleus accumbens and the orbitofrontal cortex are activated, which are the areas of the brain that develop the pleasure circuit [65].

As it can be seen, neuromarketing tools have a wide area to be utilized, also in academic research. Varga et al. [66] examined the role of familiarity in decision-making by using fMRI, proving that it plays a significant role in decision-making. Karmarkar et al. [67] examined how the timing of price information affected purchase decisions, finding that price priming shifts uncertainty towards possible investment. Still, the greatest power of neuromarketing research lies in elevating behaviour prediction precision: as studies confirm, despite their small sample sizes, they can provide a solid basis for market predictions of larger populations [68,69].

Another different question is that of ethical concerns about the use of neuromarketing techniques. Some years ago, the term brain scam appeared in reference to the belief that there was consumer manipulation and lack of privacy [23]. Nevertheless, according to Stanton, Sinnott-Armstrong, and Huettel [70], on the one hand, frequently raised concerns, such as threats to consumer autonomy, privacy, and control, do not rise to meaningful ethical issues because of the current capabilities and implementation of neuromarketing research. However, potentially serious ethical issues may emerge from neuromarketing research practices in industry, which are largely proprietary and opaque. Research carried out by the Advertising Research Foundation found clear disagreements among neuromarketing devices companies about what their techniques predicted regarding how advertisements performed. Additionally, it found differences in terminology and metrics [71]. To increase transparency, practitioners need to increase the quantity and quality of communication with stakeholders, explaining the limitations, reach, and consequences of neuromarketing techniques [72]. On the other hand, neuromarketing has clear potential for a positive impact on society and consumers due to the clear advantages in regard to understanding and addressing consumers' needs, treatment of compulsive buying disorders or other consumer addictions, or its capacity to enhance public safety campaigns [64].

As Nemorin [9] (p. 63) stated, "the truly worrisome aspect of neuromarketing lies—in the acquisition of academic knowledge, and the application of such knowledge by experts in situations that seek to strategically manipulate consumers to take consumptive (or political) action" (i.e., Neurons Inc., Cambridge, UK). As an example of this concern and according to Schneider and Woolgar [73], neuromarketing practitioners from experimental data can create consumer profiles used to categorise individuals and groups as particular brain types, or "brainotyping". The brainotype can be used as a segmentation variable and create segments based on their expected response to particular commercial messages.

6. The Metrics in Neuromarketing

One of the great differences of neuromarketing with respect to traditional techniques lies in the measures they use. On the one hand, traditional techniques look for words and explicit answers, so they measure through questions (open, closed or mixed, and spontaneous or suggested responses) or look for more statistical measures using comparative scales (such as the Constant Sum Scale, Guttman Scale, Scale of paired comparisons, etc.) and non-comparative scales (such as the Likert Scale, Semantic Differential, Stapel Scale, etc.) to finally apply quantitative analysis by interpreting means, frequencies, correlations, inferential test, or causal hypotheses, among others.

On the contrary, neuromarketing measures responses through physiological changes, such as brain waves, heart rate, or skin sweating. Neuromarketing works with computational models and not with brain maps, since the same area of the brain can be activated for different reasons. For this reason, calibration stimuli are carried out in the first place that allow generating computational models of the brain of each subject and thus can observe and subsequently compare the changes that occur in the participants after receiving certain stimuli [74]. In addition, it must be taken into account that, depending on the type of information that the brain receives (for example, visual or auditory information), the way in which it processes it will be different and, therefore, the way in which the information is measured will also vary [75]. For example, functional magnetic resonance imaging can separate simultaneous psychological processes based on their spatial and temporal parameters—this is suitable for distinguishing whether different types of decision processes induce similar or different neural processes, and, accordingly, whether they have the same neural representation with similar or different psychological processes. With the refined, sophisticated method that is applied during any research, the stimuli reaction is always separated from other neurological (or brain-controlled) activities or any other physiological body reactions (i.e., swallowing, blinking, hearing, chewing, etc.).

If the study is carried out using eye-tracking, the visual attention and movement patterns of the user can be measured with extraordinary precision by observing the flashes

of light that are reflected in the cornea and in the centre of the eye’s pupil. The metrics obtained with the use of this technique are numerous and varied, among which, the following can be highlighted [76]:

- Fixation: this is the period of time during which the eyes focus on a specific object. In addition, the fixation sequence and the time that elapses until the first fixation can be measured;
- Displacement of the eyes: this is analysed if saccades occur, which are the movements that occur in the eyes between fixations, or slow pursuit, which occurs when the eye follows the trajectory of an object without exceeding thirty degrees per second;
- Colour maps: this is a representation of the fixations and movements of the sight in the subjects through the colour red (high number of fixations), yellow (intermediate number of fixations), green (low number of fixations), or absence of colour (users have ignored that area).

If electroencephalography is used, the activity produced by neurons in the brain is being measured, the effect of which is tracked by amplifying the signal through electrodes [77]. When these types of techniques are combined with virtual reality, brain waves are usually established as a dependent variable, which are found in Hertz units (delta from 1 to 3 Hz; theta from 3.5 to 7.5 Hz; alpha from 8 to 13 Hz; beta from 12 to 30 Hz; gamma from 25 to 100 Hz) and allow identifying the cognitive or emotional impact according to its type [32–34].

Likewise, functional magnetic resonance imaging measures and records those areas of the brain that are most active when exposed to certain stimuli [77]. The aforementioned BOLD signal is commonly used as a dependent variable in these studies. The galvanic response of the skin, on the other hand, measures the reactions and changes that occur in the skin and in its sweating when the subject is exposed to a marketing stimulus that is physiologically exciting [78].

In addition, with facial coding, the facial reactions that the user has in front of the stimuli to which they are exposed are identified and measured [77], and this is without the need to use sensors, registering the voluntary and involuntary movements of the facial muscles and associating them with emotional and cognitive states through algorithms that translate these physiological changes into cognitive or emotional information [78].

The metrics used are very varied and can be classified according to whether the cognitive, emotional, or visual part is analysed. Table 2 summarizes the different variables or metrics that are obtained with the use of neuromarketing techniques.

Table 2. Variables and metrics in neuromarketing.

Cognitive	Emotional	Visual Behaviour	Implicit Association
1. Attention It measures the degree of concentration	1. Emotional activation Measure emotional changes during the study	1. Visual interest It makes it possible to know which elements have caught our attention and which have not.	Visual interest It makes it possible to know which are the elements that have captured our attention and which have not. It measures the degree of association between a stimulus and a person in a way that allows us to find out if there are attributes that provide a greater brand association
2. Comprehension It measures the cognitive load, i.e., the effort when carrying out an activity	2. Emotional impact Measures the variations in intensity that occur in each emotional change	2. Visual behaviour It allows knowing in what order the elements that the participant is observing are displayed	
3. Engagement Indicates the degree of involvement or interest with a stimulus	3. Emotional valence Indicates whether the emotion is positive or negative		

Source: the authors themselves from [49].

7. Use of Neuromarketing in Spain and Hungary

With traditional market research, companies have been able to understand what consumers think and say. However, in the current business competitive reality and consumer empowerment, such information is insufficient. In this sense, the demand for market studies with neuromarketing techniques has increased considerably. Consequently, the number of companies and experts in neuromarketing has increased significantly [79].

Indeed, the consolidation of neuromarketing brings with it another undoubted situation: the growing demand for research. Consequently, one out of three brands in Europe already use this type of technique to investigate the market [76]. However, according to the Grit Report study carried out in 2017, Spain is behind in relation to European industry in the use of technology applied to market research, including neuromarketing techniques, whose percentage of use is 19%, compared to 31% in the UK and 26% in Europe [80]. New professionals in the market with open minds, who are increasingly trained and who have a multidisciplinary nature, are essential [81]. Consequently, the Spanish Neuromarketing and Neurocommunication Association was created in Spain with the aim of achieving maximum professionalism, reliability, and recognition in this area. In addition, the association conducts investigations in order to obtain new knowledge that favours the advancement and development of neuromarketing [82]. Likewise, in Spain, there are many companies that are currently specialized in neuromarketing. They have the latest technology and tools, such as electroencephalography, fixed and mobile eye-tracking, and GSR, among others, to study and investigate human behaviour in marketing environments and offer their clients proven and effective techniques and results. Table 3 shows some of the most important companies in Spain [83].

On the other hand, many Spanish universities currently have numerous advanced neuromarketing techniques, and studies and research are being carried out in them. The Polytechnic University of Valencia (UPV) has, since 2015, established neuromarketing laboratories with the latest technology and advanced software; specifically, it has eye-tracking, facial coding, Galvanic skin response meters, electroencephalography, and virtual reality. Furthermore, it has collaborated with various companies, such as L'Oréal, Vichy laboratories, Mayoral, Educa, Fiapas, and the Ubesol group. Likewise, a group of researchers from the UPV and the University of Valencia developed a novel method that is ideal for forecasting, with a high degree of accuracy, the number of users who will see an advertisement on YouTube [84]. In addition, the department of commercialization and market research at the University of Valencia has a laboratory in which eye-tracking experiments and tests for academic purposes related to doctoral theses and research projects have been carried out since 2019.

Sanjuan and Royo-Vela [85] carried out research on neuromarketing used by and attitudes towards marketing research professionals in Spain, and the results showed that it can be concluded that market research professionals showed a moderate, but positive, attitude towards neuromarketing, this being significantly higher in women and in those who are currently working with these techniques. In general, neuromarketing is considered to provide valuable information for research and is mostly used in a complementary way for qualitative and quantitative techniques. On the other hand, the sectors where these techniques are most used are the commercial and food sectors, with eye-tracking being the most used technique. In addition, it is used to a greater extent to determine variables, such as offline and online communication. However, as it is not a main technique, it is rare for clients to demand its use and, consequently, the percentage of research that is devoted to neuromarketing is rather low. Even so, the future that is expected by market research professionals is that its use will continue to increase, albeit gradually, and that it will continue to be complemented by other research techniques.

Table 3. Most important neuromarketing companies in Spain.

Companies	Activity Description	Projects
Inside Brain	Neuroscience Centre that investigates human behaviour and its link with commercial activity.	Study for the Liga BBVA to analyse the profitability of sports sponsorship. Eye-tracking techniques were used to determine attention paid to the different advertising elements.
Sales Brain	They focus on the part of the client's brain that makes the decisions. They are based on NeuroMap scientific research.	Together with Sigma Dos carried out a study using electroencephalography and eye-tracking to determine the neural reactions produced in voters by the main political leaders in the general elections in Spain, 2015.
Neurologyca	They recreate real situations through virtual reality and discover patterns during the selection and purchase process. Digital. Retail. Branding. Communication. UX.	In 2019, they developed Multisource [®] technology based on their own technology such as Jarus, an online neuromarketing platform with its own development of very precise online eye-tracking and facial coding, and Saturn [®] , a panel based on emotional data.
Bit Brain	It started as a spin-off of the University of Zaragoza. Now, they collaborate with universities throughout Europe.	Study for L'Oréal in order to determine the emotional engagement they achieved at the point of purchase and assess the reaction of consumers to the location of their products on the different furniture or stands.
Sociograph	They have experimented with the electricity of the skin to record the moments when they are most excited by music.	A study using a bracelet with two sensors that were placed on the index and middle fingers of the subjects in order to measure and analyse the level of attention, stimuli, and emotions of listeners to a pop singer and thus choose his second single.
Neurofactory	It has a wide variety of technology: electroencephalography, eye-tracking, heart rate meter, facial recognition, and so on	
m + f = !	Customers from different countries. They use brain-pleasing marketing methods.	
FiveRooms	Specific equipment and software that record the bioelectrical activity of the brain (EEG) through sensors and are capable of monitoring brain activity in seconds, as well as combining it with visual exploration (eye-tracking).	
NeuroYes	It measures and analyses biometric, brain, and visual behavioural signals. It applies neuromarketing principles to UX.	
Emotion Research LAB	Human behaviour analysis technology through the facial recognition of emotions applied to neuromarketing and neuropolitics.	Survey at an airport after a flight to determine the level of satisfaction. Questions are asked about different services and moments, and emotional responses are measured in real-time through microfacial recognition.
Quatechnion I3B (Leni)	Technological solutions based on consumer neuroscience, AR/VR, and AI	The project RHUMBO uses mixed reality technologies (MRT) together with different biometric signals, supported by artificial intelligence-processing techniques to examine consumer behavioural patterns during dynamic, complex, and realistic situations for a deeper understanding of internal human psychological states. The project ATEMIN develops a platform that allows the measurement, assessment, and training of factors related to decision-making in the context of occupational risks. It uses implicit measures and virtual reality and psychophysiological measures. This provides information about the individual implicit brain processes.

Source: the authors themselves from [27,49,68].

Considering Hungary as a much smaller market compared to Spain, the country offers limited neuromarketing approaches so far. The most notable is the eye-tracking service, which is available quite widely as most market research companies offer this solution to their clients, such as NRC, GfK Hungária, ET Research, Szinapszis, or Prime Rate. Another approach is used by Synetiq, which collects, analyses, and interprets physiological data from a variety of wearable sensors and smartwatches, either in the lab or in people's homes, to help its customers produce better, more effective, and more memorable content. However, there is an increasing academic interest towards neuromarketing, or more precisely, consumer neuroscience. In 2020, the Budapest Management Review published

a special issue on consumer neuroscience, where Hungarian marketing labs published their results. Varga et al. [66] investigated the neural correlates of consumer ethnocentrism in 16 volunteers using a block-design fMRI paradigm. Their findings shed light on the neurological background of familiarity, allowing a better understanding of the underlying neurological processes behind consumer decisions. Gönczi and Hlédik [86] compared the usability of two webshops using different methodologies (eye-movement-tracking, qualitative interviews, and questionnaires) and revealed the usability problems in the online shopping-decision process. They investigated how the task complexity affects the usability of the website. Piskóti and Nagy [87] examined the attitudes of local marketing professionals and marketing academics towards neuromarketing research. They also demonstrated through the results of a specific neuromarketing study how useful neuromarketing research can be, supporting brands to optimize brand loyalty and brand attitude. Lázár and Szűcs [88] focused on the evaluation of eye-tracking methodology, particularly to define the appropriate sample size. Generally, this method, similar to most neuromarketing research, can provide reliable statistical results with a small sample size due to the similarity of the brain mechanism. They attempted to summarize the literature recommendations about the appropriate sample size in eye-tracking projects if reliability is a relevant aspect.

8. Academic Research Using Neuromarketing

As neuromarketing became the interpretation for business or market-related usage, the term “consumer neuroscience” was formulated to cover academic approaches using such methods. Huettel et al. [89], Cohen and Sweet [90], and several other researchers have, in recent years, sought to develop methods for the optimal use of tools that are technologically advanced and have now become sophisticated, combining quantitative and qualitative methods that are increasingly used worldwide. They are used to validate existing research, as well as stand-alone, full-fledged research. The most-used devices in academic research are fMRI, eye camera, and EEG. According to Huesing [91], roughly half of the research based on neurological imaging is performed using fMRI; therefore, in this chapter, we try to present the research designs that can be used in fMRI research.

Any consumer neuroscience research is structured similarly to traditional research [39,92–95]. However, traditional frameworks should be supplemented according to the specifics of the method. Based on this, the neuromarketing research can be divided into the following steps: formulation of research questions (1), selection of tools or the appropriate combination of tools (2), design of the most appropriate test protocol for the tool (3), data collection (4), evaluation of the obtained data (5), and presentation of results (6).

A number of details are worth considering when formulating research questions: the uniqueness of the expected data (1), the exploitation of the benefits of brain research (2), the establishment of theories and hypotheses consistent with the theories of social sciences and neuroscience (3) and, preparing to treat idiosyncrasy (hypersensitivity) caused by the environment of each device.

The development of a study protocol is the most sensitive phase of any consumer neuroscience research. When choosing the right combination of tools, the primary consideration is to consider the well-defined research question. As a researcher using neuromarketing, it is not necessary to strive to use all available tools at all costs to answer a question, but to do so, you need to be aware of the pros and cons of each type and the type and quality of data (answers) they provide. For example, as in most experiments, the study using fMRI focuses on the study of different dependent and independent variables [89]. The independent variables are those that the researcher can modify during the experiment and that are used to test the hypothesis. The dependent variables reflect the data examined by the researcher, so they can provide evidence to support or refute the hypothesis. That is, the quantities used to evaluate the effects of the independent variables. Most fMRI research considers the changes in the BOLD signal (blood-oxygen-level-dependent signal) as the primary dependent variable.

The evaluation of the obtained data in neuromarketing research is always based on teamwork. Marketing professionals play a significant role in determining the focus of research, but the presence of a researcher with a neurological background is a prerequisite for evaluating the data. When compiling the different tool combinations, not only is the availability of each tool a determining factor, but also the presence of a researcher who is able to sort and interpret the output data. Different tools require different expertise; one skilled in the art of fMRI evaluation may not be an experienced EEG analyser, and vice versa.

During the presentation of the results, effort should be made to answer the research questions and present the theoretical, practical, and, where appropriate, managerial implications of the results. It is a general experience that the results of consumer neuroscience research (due to their complexity) are more difficult to interpret, so their interpretation and transposition into practical use is difficult, even for experienced researchers.

Regarding the findings in academic research, over the past decade, significant advances have been made in the neurological examination of decision-making (which includes results from neuroscience, consumer neuroscience, and social neuroscience) [96]. Thus, for example, we can know what brain processes take place when making a purchasing decision, i.e., how the consumer evaluates different decision options, how they are compared to make a decision, and how much context influences these processes [97]. For example, Erk et al. [98] examined the mechanism of choice between different products on the example of cars, exploring the relationships between the attributes of each product and the neurological background. Products that represent wealth and higher status have been shown to generate higher activity in the brain areas responsible for rewarding, and Deppe et al. [99] examined both the mechanism of choice between brands and the influence of brands on the assessment of credibility. Based on their results, it can be stated that, in the decision-making processes, favourite brands reduce analytical thinking and lead more to the activation of the brain areas responsible for rewarding. Furthermore, it was found that, where credibility is questionable, brands have a significant influential role in decision-making (also through increased activity in the brain areas responsible for a sense of reward).

The neuromarketing research method can be used in a number of areas: value judgment and decision network [100], self-control [101], or framing [102]. In the field of consumer neuroscience, we can find research on all elements of the marketing mix (4P—price, product, place, and promotion). For example, McClure et al. [26] conducted research on taste perception, which explored the extent to which brand knowledge influences taste perception. It was found that, if the subject of the research consumed the product of their favourite brand, the brain areas responsible for rewarding were more activated.

Finally, research on pricing, branding, retailing, and packaging is also very popular [103–107]. For example, Plassmann et al. [108] examined loyal and non-loyal consumers, revealing the neurological background responsible for the development of brand loyalty (brand-loyal consumers showed significantly different, increased brain activity for the preferred brand). Schaefer et al. [109] also examined automotive brands in response to the neurological implications of the influential cultural background behind the brands. The crucial role of the prefrontal cortex in brands with a cultural context has been successfully demonstrated. Yoon et al. [110] also examined the choice between brands, looking for parallels between human and brand personalities. They found that these two activate different areas of the brain, making it difficult to draw parallels between them in a neurological sense.

Fuduric, Varga, Horvat, and Skare [111] conducted four studies in three product categories and five countries using the implicit association test (IAT) to explore implicit and explicit attitudes towards private labels and manufacturer brands, and their ability to predict purchase intention. Their findings indicated that the IAT can be used to measure implicit brand preferences and that consumers both implicitly and explicitly perceive manufacturer brands more positively.

9. Conclusions

Neuromarketing and consumer neuroscience are evolving at a rapid pace. Surrounded by rapid changes in the economic and technological environment as well, four trends have been shaped in neuromarketing: mobility, acceleration, relatively declining prices, and better (more accurate) data collection and processing. In this case, mobility means a shift away from the laboratory environment using mobile and wireless versions of most devices, allowing researchers to work in a real or lifelike environment. Owing to social and technological developments, data collection and evaluation have accelerated and become more accurate. Due to the intensification of market competition (as more and more market research companies have included neuromarketing research), the price of individual research has also decreased in recent years.

As neuromarketing is closely linked to neuroeconomics and its associates, it is providing a solid framework for decision-making processes to explore neurological processes. In the future, disciplines, such as social and emotional neuroscience, may play an important role in expanding this research field. Some other approaches can provide important added value to organizational research, ideally increasing the role of consumer-focused, as well as organization-centred research, in behavioural research. International market research firms have established their own neuromarketing divisions (e.g., Nielsen, Millward Brown, GfK, and TNS), and, as a result, the application of neuroscience research and techniques already helps to understand consumers (or more precisely, their decision-making process) more effectively, both theoretically and practically. The trend of using a combination of tools in research is already visible. The examination of a given theory, or the explanation of a specific consumer behaviour, is significantly more well-founded than a research program using only one tool. Although the tools are fundamentally the same as they were 20 years ago, the methods, analysis, and technology itself have evolved a lot in recent years. For example, one of the latest trends is the application of nanotechnology in consumer decision-making research [112].

A better understanding of our brains is driven not only by marketing research, but also by many disciplines in general. This kind of pressure appears in brand research or organizational research. This trend is widely publicized and (through valuable data provided by current research) models, theories, and analysis can be integrated into other social science research. Business research already includes an interdisciplinary approach, drawing on economics, psychology, communication, and many other fields. Research in neuromarketing or consumer neuroscience plays a connecting role in promoting the development of neuroscience, as well as biology or genetics. In the future, neuromarketing is expected to enrich the theory of consumer psychology and expand business research.

All in all, this innovative market research technique, which is multidisciplinary in nature, provides relevant information with great added value. It is a technique that, unlike traditional methods, does not ask users questions, but instead introduces stimuli and observes the reactions that occur at the brain level, trying to understand the consumer's subconscious. In this way, neuromarketing avoids possible biases derived from non-spontaneous responses influenced by different variables and provides truthful and objective information on consumer reactions.

The truth is, it is undeniable that the information obtained through neuromarketing is extremely relevant and it would be very difficult or practically impossible to obtain it with just traditional techniques. This is clear from both literature and fieldwork that has been introduced in this chapter. However, despite the great added value that neuromarketing could provide, its use is still not entirely generalized, although it is used in more and more different sectors (commercial, tourism, music, etc.).

The limited use of this technique may be due to several factors: its relatively high cost, laborious practical application, or the complexity of metrics that are used. As it was described throughout the theoretical framework, neuromarketing measures in an entirely different way than the metrics used for traditional techniques. It poses a clear obstacle when incorporating it into common research processes. Indeed, the metric is one

of the drawbacks of neuromarketing and it should be agreed upon and improved among professionals and academics.

Likewise, as the specific techniques used in neuromarketing have been described above, some of the most used are eye-tracking and EEG in academic and market research, and fMRI in academic research. It is unlikely that neuromarketing will ever replace traditional techniques entirely, but it serves and will serve as an important complementary role to current qualitative and quantitative techniques.

It should be noted that when neuromarketing studies emerged, ethical concerns were raised, and it was feared that it will serve as an irresistible control over consumers' free will. As for today, these concerns were deflated and neuromarketing has found its rightful place amongst market research techniques.

Neuromarketing still has a long way to go in which, of course, many aspects will have to be improved so that its use becomes more widespread, and that professionals and academics incorporate it as a more common research technique. Even though it is expected to continue to complement other techniques, the future that awaits neuromarketing is not stagnation, but, predictably, its use will increase progressively, although gradually.

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