

## Neuromarketing: concept, historical evolution and challenges

Neuromarketing: concepto, evolución histórica y retos

Neuromarketing: conceito, evolução histórica e desafios

Coral Cenizo<sup>1</sup> 

<sup>1</sup> Researcher (San Pablo CEU University), España

Recibido: 29/06/2021; Revisado: 14/07/2021; Aceptado: 07/10/2021; Publicado: 01/01/2022

*To cite this article:* Cenizo, C. (2022). Neuromarketing: concept, historical evolution and challenges. *Icono 14*, 20(1).  
<https://doi.org/10.7195/ri14.v20i1.1784>

### Abstract

In an increasingly competitive world, many experts are searching for the answer to the Holy Grail of marketing: what drives consumers to choose one product over another? What factors influence a consumer's perception of a brand? Many believe that the key is neuromarketing. However, this discipline faces a deep lack of knowledge, both in the scientific and business communities, which is causing uncertainty about the real possibilities it offers. This article aims to shed more light on this matter, analyzing its history—from its origins to the present—, as well as its conceptualization and the challenges it faces, through an exhaustive review of scientific literature. The results offer a complete state of the art, essential to understand the real meaning of the term neuromarketing, the situation of instability in which the discipline finds itself, the limitations that are constraining its development and the research deficiencies to date. This article constitutes a cornerstone to support future research or practical applications of neuromarketing.



**Keywords:** advertising; decision making; consumer; neuromarketing; neuroscience; market research

## Resumen

En un mundo cada vez más competitivo, muchos expertos y teóricos siguen buscando la respuesta al Santo Grial del marketing: ¿qué lleva a los consumidores a elegir un producto en lugar de otro? ¿Qué factores influyen en la percepción que tiene un consumidor de una marca? Muchos creen que la clave está en el neuromarketing. Sin embargo, esta disciplina se enfrenta hoy a un profundo desconocimiento, tanto en la comunidad científica como empresarial, que está originando incertidumbre sobre las posibilidades reales que ofrece. Este artículo pretende arrojar más luz sobre esta materia, analizando para ello su evolución histórica —desde sus orígenes hasta la actualidad—, así como su conceptualización y los retos a los que se enfrenta, mediante una revisión exhaustiva de la literatura científica publicada hasta el momento. Los resultados ofrecen un completo estado de la cuestión, esencial para entender el significado real del término neuromarketing, la situación de inestabilidad en la que se encuentra la disciplina, las limitaciones que están constriñendo su desarrollo y las carencias investigadoras. El artículo constituye una piedra angular sobre la que sustentar futuras investigaciones o aplicaciones prácticas del neuromarketing.

**Palabras clave:** publicidad; toma de decisiones; consumidor; neuromarketing; neurociencias; investigación de mercados

## Resumo

Em um mundo cada vez mais competitivo, muitos especialistas e teóricos continuam em busca da resposta para o Santo Graal do marketing: o que leva os consumidores a escolher um produto em vez de outro? Que fatores influenciam a percepção do consumidor sobre uma marca? Muitos acreditam que a chave está no neuromarketing. No entanto, essa disciplina hoje enfrenta um profundo desconhecimento, tanto na comunidade científica como empresarial, o que vem gerando incertezas sobre as reais possibilidades que oferece. Tendo em conta o pequeno número de artigos científicos publicados em espanhol, este artigo pretende lançar mais luz sobre esse assunto, analisando a sua evolução histórica —desde as origens até ao presente—, bem como a sua conceituação e os desafios que enfrenta, por meio de uma revisão exaustiva da literatura científica relacionada ao neuromarketing. Os resultados oferecem um estado da arte, essencial para compreender o real significado do termo neuromarketing, a situação de instabilidade em que a disciplina se encontra, as limitações que condicionam o seu desenvolvimento e as deficiências da investigação até à data. O artigo constitui uma pedra angular sobre a qual apoiar pesquisas futuras ou aplicações práticas do neuromarketing.

**Palavras-chave:** publicidade; tomada de decisão; consumidor; neuromarketing; neurociência; pesquisa de mercado

# 1. Introduction

For years, traditional economic models defended that it was the rational motivations of consumers, marked by the fulfillment of their own interests, that marked the purchasing processes (Thompson, 2013). Although this statement is still true, numerous studies (Dooley, 2011, and Ramsay, 2014, to cite two examples) have cast doubt on whether purchasing decisions are guided solely by rationality; in fact, some experts defend that our purchasing decisions are more emotional than we think and that the conception that the human being is a cognitive machine driven by rational decisions is out of date (Lindstrom, 2010; Shiv and Fedorikhin, 1999; Sinek, 2009; Hazeldine, 2014).

Precisely for this reason, in current marketing it is not enough for a product or service to have a rational competitive advantage, but also that the consumer has emotional levers and a shopping experience attractive enough to influence their purchase decision, beyond its objective limits (Levy and Weitz, 2009). Understanding, therefore, the unconscious of consumers is essential today.

In all this context, neuromarketing has appeared as a possible solution to this enigma to the point that some authors speak that its study and development will mark a before and after in the marketing sector (Perrachione and Perrachione, 2008).

However, and despite its potential to assess consumer subliminal reactions to brands, products or marketing materials and determine which elements most influence the purchasing decisions, there is a profound lack of knowledge about this discipline. This in turn is generating a limited vision of the issue, misunderstandings and an undeservedly erroneous reputation that is spreading highly distorted images about what neuromarketing really is and the possibilities it offers (Dooley, 2015; Samuel and Prasanth, 2012).

## 2. Methodology

This article is based on three main research objectives; first, to investigate the term neuromarketing to find out its essence and scope. There is currently a distortion of the word neuromarketing, to the point that it is used indiscriminately and erroneously by the media and citizens in general (Monge and Fernández Guerra, 2012). Therefore, it is necessary to specify a complete and correct definition in order to correct these deviations.

Second, it is intended to study the historical evolution of neuromarketing to understand how the perception of the discipline has changed, its existence within the scientific and professional field, as well as the controversies that have arisen around it, from its birth to

the present day. This historical analysis seeks to create a general framework that allows us to understand how this discipline has reached the current situation in which it finds itself.

Third and last, we intend to analyze the main challenges that neuromarketing faces today; Understanding these challenges is essential to detect avenues for improvement and also to understand what aspects are limiting the development of neuromarketing and its widespread application in the professional and research field.

In order to respond to these three objectives, an exhaustive review of the scientific literature related to neuromarketing has been carried out, from the pioneering research published in the early 2000s to the most recent, which analyzes the most recent applications of neuromarketing. In total, 67 sources have been studied —between indexed scientific journals and reference works— that have obtained a notable impact in the scientific field due to their quality or results.

A qualitative theoretical analysis has been carried out on this corpus, using a descriptive approach that does not intend to assess the object of study but rather to analyze its nature in the most objective way possible in order to build a theoretical base as aseptic as possible.

## **3. Development**

### **3.1. The concept of neuromarketing**

The term neuromarketing emerged in 2002 when Professor Ale Smidts published his article "Kijken in het brein" ("Looking into the brain"); However, when the article was translated into English, its title was adapted to "Looking into neuromarketing", thus introducing the term neuromarketing for the first time in the sector (Smidts, 2002). However, although Smidts is credited with coining the term neuromarketing (Orzan, Zara & Purcarea, 2012), the origin of the discipline dates back to 1999, the year in which the first fMRI (functional magnetic resonance imaging) study was conducted with marketing purposes by Professor Gerry Zaltman (Roeduck, 2011).

Perhaps due to its complexity, numerous definitions of the term neuromarketing have been coined. Smidts defined the concept as the study of brain mechanisms and processes to understand consumer behavior patterns in order to improve marketing strategies (2002).

A similar approach is taken up by Lee, Broderick and Chamberlain who understand that neuromarketing involves the application of neuroscientific methods in marketing in order to analyze and understand human behavior; in other words: neuromarketing

seeks to understand the way consumers think and the reasons that push them to choose one product or brand over another, applying neuroscientific methods (2007). With this definition, the authors already laid an important foundation as they expanded the scope of neuromarketing, encompassing aspects that go beyond the study of consumer behavior.

Even more precise is the definition provided by Dooley for whom neuromarketing is a new area in marketing research that studies the cognitive and emotional responses of consumers to different marketing stimuli (2010).

What seems clear is that neuromarketing is an interdisciplinary field that combines elements of neuroscience and psychology with theories of consumer behavior in order to explain what drives the consumer to make their final purchase decision (Marichamy and Sathiyavathi, 2014). At first, it arose as part of neuroeconomics, hence it is considered a field located between neurosciences and economics whose objective is to explain the decision-making process through the development of neural models and systems (Pop et al., 2014; Egidi, 2008).

There are various techniques within neuromarketing; these can be divided into those that record activity within the brain and those that record activity outside the brain. The first technique of the first group is the Functional Magnetic Resonance (fMRI) that measures, by means of magnetism, changes in the oxygenation of the blood, in turn related to the activity of the brain; in this way, fMRI offers images of the brain while it is working to analyze neuronal responses to stimuli. The second technique is electroencephalography or EEG, which analyzes, using electrodes placed on the scalp, the areas of the brain in which the greatest activity is taking place; unlike fMRI, the cost of EEG is lower, which has made it one of the most widely used techniques in neuromarketing. The third technique is magnetoencephalography or MEG; similar to EEG, MEG measures magnetic fields that are produced by neuronal activity; MEG offers better quality and temporal resolution than EEG, but the high cost of the necessary equipment means that its use is very low.

In the second group we find electromyography or EMG, which consists of the application of low voltage electrodes in the muscles to study the electrical activity that these generate when involuntary emotional responses are produced; EMG is typically used on the facial muscles to monitor expressions that are very brief and invisible to the naked eye. Another technique is the Facial Action Coding System (FACS) which measures, by observing facial expressions, the muscular reaction to certain stimuli; this technique began to be used in the seventies through the experiments developed by Paul Ekman; at present it is developed through specific software (Azcarate et al., 2005). The third technique of this group is ocular tracking or eye-tracking; in this case, where the subject is looking is analyzed, something especially useful if there are multiple stimuli or if contextual information is needed.

Despite the diversity of current techniques, all of them work in the same direction, that is, to study through bodily activity the cognitive, sensorimotor and affective responses of consumers to specific marketing stimuli (Ohme et al., 2009) and determine if certain

changes in these stimuli in turn cause modifications in the body signals (Kenning and Plassmann, 2008; Riccio et al., 2015; Rodrigues, 2011).

Supporters argue that neuromarketing provides information that is impossible to obtain through normal marketing research processes, such as interviews, questionnaires or focus groups (Ariely and Berns, 2010); This is because people may not tell the truth when they are explicitly asked something that, however, neuromarketing overlooks (Calvert and Brammer, 2012). For other authors, trying to get consumers to rationally express their emotions about a product or marketing material cannot be considered a valid source of information; the bias that undoubtedly derives from this procedure makes its efficiency questionable (Oliver, 2016). In fact, this is the main difference between neuromarketing and traditional research techniques: neuromarketing offers an open window into a consumer's brain that exposes often hidden details that can make the difference between a successful marketing campaign and another failed (Colaffero and Crescitelli, 2014; Marichamy and Sathiyavathi, 2014; Mucha, 2005).

The potential value of neuromarketing is incalculable; as Arthmann and Li pointed out, there is no doubt that marketers tirelessly seek to uncover the secrets of consumers' subconscious (2017); the cost of some advertising campaigns or the development of a product can in many cases exceed several million euros; in this sense, the use of neuromarketing techniques seems reasonable if this reduces the risk in the marketing investment.

### **3.2. Historical evolution of neuromarketing**

Despite its consolidation in 2002, the field of neuromarketing evolved somewhat slowly thereafter. It was not until 2004 that academic articles began to emerge, such as the Coca-Cola vs Pepsi study, considered a benchmark in the sector even today. In this study, a group of subjects were asked to drink Coca-Cola and Pepsi while their brains were monitored using functional magnetic resonance imaging (fMRI). The experiment yielded clear results: a consistent neuronal response was detected in the ventromedial prefrontal cortex that was correlated with the subjects' preferences for each of these drinks. Brand awareness was also shown to influence expressed behavioral preferences and measured brain responses (McClure et al., 2004).

Shortly after, the first two consulting firms that offered research and consulting services using neuromarketing techniques were born: BrightHouse and SalesBrain; with this, the adoption of technologies associated with neurosciences within the business and marketing fields was established (Fisher et al., 2010; Alwitt, 1985).

The following years were marked by the opposing positions. On the one hand, great optimism was generated about the possibilities that neuromarketing opened; proof of this

are the words of Pop, Radomir, Ioana and Maria who stated that the only way to objectively measure the thoughts and feelings of consumers was through neurosciences (2009). This optimism also coincided with the cheaper neuromarketing techniques that made their use and testing more affordable.

Fugate, for example, came up with a list of areas in which neuromarketing was especially useful compared to traditional marketing research techniques, such as advertising effectiveness, logo selection, attractiveness of certain products, etc. (Fugate, 2008).

However, at that time criticism also arose; Some experts pointed out that neuromarketing was unethical, even exceeding the limits of legality (Lee et al., 2007). Others spoke of the high costs associated with the different techniques that did not compensate for the results obtained (Hubert and Kenning, 2008) and even of the negative influence that it could cause in society since it set a precedent that could lead to the manipulation and control of the individuals by brands (Murphy et al., 2008).

There were also those who maintained a position of skepticism, arguing that neuromarketing was just a passing fad that would not offer any Holy Grail that would allow discovering the mysterious button that prompted a consumer to buy (Lewis and Bridger, 2005).

Controversy aside, neuromarketing began to gain popularity in the following years, partly because of the hope that different techniques would be cheaper and faster compared to other research methods, and also because of the fact that neuromarketing provided information that could not be obtained in any other way (Ariely and Berns, 2010). Neuromarketing began to be seen as a field devoid of magic, with its own limitations, but which offered valuable information to understand the complexities of consumer purchasing decisions (Yoon et al., 2012).

Thus, between 2010 and 2015, numerous articles were published in which the advantages and disadvantages of the different techniques associated with neuromarketing were analyzed, which made the field begin to gain more strength as a reliable research tool (Bercea, 2012).

But neuromarketing not only captured the attention of the academic and research world but also the business world; thus, the number of companies and consultancies dedicated and specialized in this field increased (Plassmann et al., 2012). The number of searches for the term on the Internet also increased: from 800,000 searches in 2008, it went to almost a million and a half in 2021 and from there to three million in 2018 (Hubert and Kenning, 2008).

This boom was consolidated with the founding in 2012 of the Neuromarketing Business and Science Association (NMBSA), whose mission, beyond promoting neuromarketing

worldwide, was to establish a methodological basis for this field and thus favor its acceptance in the scientific community.

But despite its growing popularity, neuromarketing continued to face harsh criticism; for example, the efficacy of neuromarketing methods was questioned and it was ruled out that they could replace traditional research techniques because the conditions of the experiments and the methodologies limited their generalization (Ariely and Berns, 2010; Solnais et al., 2013).

But despite the caution shown by scientists and the scant empirical research, specialized marketing companies such as Nielsen or Millward Brown created specialized neuromarketing departments to apply the latest techniques in their clients' marketing strategies (Plassmann et al., 2015).

It was from 2015 when the first relevant results on the matter were presented; in their article "Individual Differences in Marketing Placebo Effects", Plassmann and Weber investigated the placebo effect (MPE) in the field of marketing; specifically, this research analyzed the differences in the responses to placebo presented by individuals, using techniques based on brain activity (2015).

Another interesting article was the one presented by Chen, Nelson and Hsu; by combining machine learning techniques with functional neuroimaging, it was concluded that, unlike being built through reflective processes, the personality of a brand exists within the minds of consumers; thus, the researchers were able to predict which brand the individuals in the study were thinking about based solely on the relationship between brand personality associations and brain activity (2015).

But despite the aforementioned advances, in successive years up to the present, few scientific studies have been carried out on the matter; most research lacks empirical foundation and, on the contrary, provides reviews of past results, personal approaches or experiments that, despite their potential, are not achieving real or extrapolated progress, except to awaken interest in future research (Lin et al., 2018; Krampe et al., 2018).

Even so, in recent years there has been a growing interest in aspects related to neuromarketing, such as its ethical dimension; an example of this is the article signed by Stanton, Sinnott-Armstrong and Huettel in which the ethical risks derived from the techniques and uses of neuromarketing are detailed (2017). Hensel, Iorga, Wolter and Znanewitz maintain a similar approach; through a series of interviews with neuromarketing professionals, they confirmed the importance of maintaining and respecting the ethical aspects of neuromarketing in order to ensure both the quality of the results and the protection of participants. The authors also contributed five ethical measures to ensure the transparency and objectivity of neuromarketing (2017).



Also in recent years there has been a change in perspective in the conception of neuromarketing; faced with the autonomy and independence of the subject defended in the early years, currently there is a more tempered position that considers neuromarketing as a complementary research technique, not a substitute, for traditional methodologies to understand consumer decision-making (Stanton et al., 2017; Hsu, 2017). A good example of this supplementary role of neuromarketing is found in the research proposed by Nave, Nadler, Dubois, Zava, Camerer and Plassmann in which the analysis of brain activity reaffirmed the results obtained through the correlation between testosterone levels and the preferences of consumers for luxury brands (2018).

Nor should the recent advances in the conceptualization of neuromarketing be overlooked; for example, Knutson and Genevsky proposed in 2018 a new concept related to matter: neuroforecasting; with this term, the authors defined the ability to anticipate future consumer purchasing decisions using brain imaging. Knutson and Genevsky proposed this concept both for individual subjects and for groups, which would allow predicting aggregate behaviors. However, the authors also invited caution by recognizing that neuroforecasting is a technique that has yet to be evolved and studied (2018).

Also recent is the application of neuromarketing to the digital field; in this sense, the studies proposed by Arthmann and Li and Constantinescu, Orindaru, Pachitanu, Rosca, Caescu and Orzan stand out. In the first case, the researchers focused on the link between neuromarketing and the Internet, as well as the benefits derived from this union; they concluded that neuromarketing can influence the association of brand and consumer loyalty proactively, as it measures the customer behavior in real time, both their verbal and non-verbal responses to new products, prices and advertising promotions (2017).

In the case of the second investigation, the use of neuromarketing in social networks was analyzed, considering the purposes of the company and the benefits of the consumer; authors created a model where purposes were combined with the corresponding benefits, showing the degree of acceptability of four major applications of neuromarketing to achieve sustainable business growth. Even so, the results showed that it was not easy to apply neuromarketing techniques to social networks due to two reasons: firstly, the high investment that the purchase of the equipment necessary to make the measurements entails for companies, and secondly, the unwillingness of individuals to take part in this type of research (2019).

Less dramatic is the evolution in criticism towards neuromarketing; although it is true that allusions to the negatively dystopian nature of neuromarketing have moderated over the years, doubts remain about its real efficacy; such is the case, of Hsu who appeals to the complexity of the nervous system to question the correspondence between specific brain regions and mental states, especially those valuable for marketing such as loyalty or love. Hsu goes further by recognizing that it is a complete error to look for a single cause in the effectiveness of marketing actions, since their success usually comes from multiple factors;

the success of an ad, according to Hsu, usually comes from a combination of emotional richness, pleasant viewing and eye-catching character (2017).

Other authors such as Lim criticize the previous researches, arguing that these studies on the subject offer very limited guidance on how solid research based on neuromarketing should be carried out; since they only analyze basic aspects of the different neuroscientific methods, they deter rather than help the development of marketing research based on neuromarketing (2018).

A similar position is held by Lee, Chamberlain and Brandes who acknowledge that the enormous fragmentation of previous research, the lack of quality methodology oriented to the user and the absence of a guide that allows distinguishing a correct neuromarketing research are limiting the potential growth of this area. (2018).

### **3.3. Challenges of neuromarketing**

Neuromarketing is a growing field, with a great variety of facets that each year arouse more interest in the scientific community (Lee and et al., 2018); however, the area faces important challenges, which we will gather below.

#### **3.3.1. Costs**

Neuromarketing is not cheap; quite the contrary, the use of techniques related to neurosciences entails a high cost, both for the purchase of materials and for the implementation of the experiments. This is, according to Hilderbrand, the main stumbling block in this field due to its limiting nature (2016); as a general framework, the cost of eye-tracking and EEG studies is between \$5,000-15,000 per ad. In the event that an advertiser wants to test more than one ad, the cost of a pretest for an ad group is around \$20,000-35,000. Even the cheapest equipment —most of them associated with EEG— cost \$10,000 (Ariely and Berns, 2010).

But the expenses not only come from the equipment and execution of the experiment; other factors that can increase the cost must also be considered, such as, for example, the selection of individuals with special traits, the size of the sample, faster results obtained or the inclusion of multiple stimuli.

The high costs of techniques such as fMRI or MEG have made consulting firms opt for cheaper options such as EEG, which, however, pose some limitations such as limited spatial resolution or the absence of data from the deepest layers of the brain. Other experts question the effectiveness of neuromarketing from the ROI point of view, although it is true

that to date no specific study has been carried out in this regard (Monge and Fernández Guerra, 2012).

### **3.3.2. Sample size**

The second most controversial aspect is the size of the samples. As we have mentioned before, the number of individuals who are part of the experiment has a considerable influence on the price of the experiments. This has led many consultancy firms specialized in neuromarketing to reduce the sample groups to adjust the costs of their services as much as possible. Most of these companies argue that the quality of the results is not proportional to the number of individuals who are part of the experiment; in fact, according to Sands Research, a sample of between 30 and 40 subjects shows only a 1% error with EEG technology (Sands, 2009).

The contrast with traditional empirical methodologies is clear: in general, market studies require a considerable number of responses to be considered valid, usually exceeding one hundred.

This difference has led many experts to question the extrapolation of data from neuromarketing. Henrich, for example, states that it is impossible to obtain conclusive results without adequate sample sizes; the author also criticizes the generalization of the results to the total population sample, taking as a reference a very specific subgroup, something very common in neuromarketing (2010).

Nor is there a clear consensus among specialized consulting firms; while some, such as Sands, strongly defend the effectiveness of the sampling of 30 to 40 people, others, such as EmSense, question these numbers and maintain that larger samples are necessary, similar to those used in other investigative techniques, to arrive at what they call «quantitative neuromarketing» (Monge and Fernández Guerra, 2012).

### **3.3.3. Ethical regulation**

The ethical regulation of neuromarketing is one of the main challenges facing this discipline. The rejection caused by neuromarketing techniques in individuals is clear; according to Lindstrom, neuromarketing causes some discomfort in individuals; this is due to the general fear that exists when giving access to the brain, considered a major intrusion with the potential to reveal our deepest thoughts and feelings. Like a sinister Peeping Tom, neurosciences are more feared than loved, partly also due to the lack of knowledge that exists around its procedures (2008).

Indeed, neuromarketing is not exempt from ethical dilemmas, many of which were collected by Murphy, Illes and Reiner in their article "Neuroethics of neuromarketing" (2008). For example, there is no filtering of the information obtained by the different neuromarketing techniques from individuals, so that they cannot choose which information to share and which not. It is true, however, that today the information that neuromarketing can extract is very limited (Tovino, 2005).

Another controversial aspect is the absence of specific regulation; unlike clinical research, neuromarketing does not have rules regulated by an independent entity that guarantee its correct application (Illes et al., 2006); thus, for example, there are no action procedures in cases where health problems are detected—which occurs in approximately 1% of cases—or for the protection of individuals with neurological vulnerabilities.

Indeed, the current development of these techniques is quite limited, but it remains up to the point that their subsequent evolution may lead to processes of subliminal manipulation or even mental control that lead individuals to act against their will. This is a fear that has traditionally always existed in the discipline and that various authors have repeatedly raised (Murphy et al., 2008).

### **3.3.4. Lack of standards**

The absence of common standards for the discipline makes each consultant apply its own methodologies to carry out its experiments, following its own quality criteria—both in data collection and in the application of technologies—, so the analysis of the results is different according to the consultant. This total diversity of methodologies makes the results difficult to compare with each other (Monge and Fernández Guerra, 2012). Thus, parallel work with two or more consultants for the subsequent comparison of results is impossible, a practice, on the other hand, common in other fields.

The youth of the discipline and the competition of the market seem to be the main causes of this diversity; it should not be forgotten that the prevailing price war between specialized companies in the sector forces the imposition of secrecy in the methodologies that makes the creation of joint standards impossible (Monge and Fernández Guerra, 2012).

There is, however, a willingness on the part of the sector to establish valid standards; the clearest case is the Neurostandards Collaboration initiative, led by the Advertising Research Foundation (ARF); this initiative brought together eight large consulting firms—Gallup and Robinson, Innerscope, LABORatory, Mindlab International, NeuroCompass, Neuro-Insight, Sands Research and Sensory Logic—in order to exchange knowledge and establish valid standards for all. The absence of two of the leading consulting firms in the market, Neurofocus and EmSense, as well as the unpromising results of the first

phase —published in 2011— conditioned, however, the initial expectations with which Neurostandards Collaboration was born.

## 4. Conclusion

With the present study we tried to answer three research questions. In the first place, to specify the concept of neuromarketing in the most complete way possible; in this sense, it has been possible to define, through the contributions of different authors, the concept of neuromarketing, as well as its most common areas and techniques of action. It has also been shown that the conceptualization of neuromarketing transcends terminological limits; the coinage of the term was the one that gave the discipline of entity and the one that established its presence in the scientific and professional field, since it is from then on when there is a greater interest in the issue in all areas. Also interesting is the fact that even though the word was born in 2002, there were already prior investigations before that date that used techniques from neurosciences for marketing purposes —such as that conducted by Gerry Zaltman—, despite the absence of the appropriate term to define it; therefore, its minting was the result of the need created in the research field.

The second objective of the research was to define the historical framework of neuromarketing, in order to understand the complex situation that this discipline faces, as well as its limitations.

In this sense, the analysis of the historical evolution of neuromarketing has allowed us to better understand the path of ups and downs that this discipline has gone through, mostly marked by conflicting positions, doubts and uncertainties. Under this framework, it is easy to understand the situation of instability that this discipline faces today, still in search of its own identity and subject to continuous debate.

Likewise, it has allowed us to detect two very important issues.

In the first place, since its inception, neuromarketing has been attributed with capacities that, at least for the moment, exceed reality; far from being the absolute key to unraveling the secrets of purchasing decisions, neuromarketing has proven to be a complementary methodology, of limited scope, which is still very far from the objectives it was intended to solve. At the same time, neuromarketing offers, to date, information similar to that of other techniques, far from the possibilities historically assigned to it, such as manipulation of individuals, changes in brain structures, among others (Levy, 2009). Whether or not neuromarketing could evolve to reach these heights is difficult to predict for sure. Some caution is necessary when assessing future possibilities so as not to fall into overly optimistic or pessimistic views.

Second, it is obvious that neuromarketing lacks a research track record; this may be due to their relative youth, which has not yet resulted in a background or a solid methodology. However, this absence is hurting, rather than benefiting, the discipline; as Dooley has already advanced, the lack of significant scientific work is generating a lack of understanding and understanding within the industry (2015). Thus, it is necessary to increase research on neuromarketing to know the real potential of this discipline in areas such as marketing or product development, to determine to what extent these techniques can be extrapolated to practice in an efficient way and to alleviate the lack of knowledge that exists about the issue (Butler, 2008).

Regarding the third research objective, with which we wanted to specify the challenges that neuromarketing faces today, it is undeniable that interest in neuromarketing is growing; more and more companies and experts see this relatively new methodology as a door to the future that allows them to develop and create more effective and economically safe marketing actions. However, neuromarketing faces, as we have seen in this research, important challenges that are hampering its development and that may condition its near future.

The high costs involved in the implementation of the different neuromarketing techniques, the discrepancy that exists around the optimal sample size, the total absence of standards that makes it impossible to compare results and, above all, the ethical dilemmas, are four major pitfalls that call into question the efficacy and growth of neuromarketing.

But, despite the current limitations, the possibilities of neuromarketing are enormous; the advances that have been made to date offer enough optimism to have confidence in the future capabilities of this discipline. The next few years will be key to laying the foundations of this field, correcting current deficiencies, creating methodological and ethical standards and reducing costs to make this discipline another tool at the service of market research.

## References

- Alwitt, L. (1985). EEG activity reflects the content of commercials. En Alwitt, L., *Psychological processes and advertising effects: theory, research, and applications* (pp. 209–219). Hillsdale, NJ: Lawrence Erlbaum.
- Ariely, D., & Berns, G. S. (2010). Neuromarketing: the hope and hype of neuroimaging in business. *Nature Reviews Neuroscience*, 11(4), 284–292. <https://doi.org/10.1038/nrn2795>.
- Arthmann, C., & Li, I.P. (2017). Neuromarketing - The Art and Science of Marketing and Neurosciences Enabled by IoT Technologies. *IIC Journal of Innovation*, 1–10.
- Azcarate, A., Sande, K.V., & Valenti, R.G. (2005). *Automatic facial emotion recognition*. <https://bit.ly/3goKE5p>.
- Bercea, M. D. (2012). *Anatomy of methodologies for measuring consumer behavior in neuromarketing research*. <https://bit.ly/355BhCe>.

- Butler, M. (2008). Neuromarketing and the perception of knowledge. *Journal of Consumer Behavior*, 7, 415-419. <https://doi.org/10.1002/cb.260>.
- Calvert, G.A., & Brammer, M.J. (2012). Predicting consumer behavior. *IEE Pulse Magazine*, 3(3), 38-41. <https://doi.org/10.1109/MPUL.2012.2189167>.
- Chen, Y.P., Nelson, L.D., & Hsu, M. (2015). From "Where" to "What": Distributed Representations of Brand Associations in the Human Brain. *Journal of Marketing Research*, 52(4), 453-466. <https://doi.org/10.1509/jmr.14.0606>.
- Colaferro, C. A., & Crescitelli, E. (2014). The Contribution of Neuromarketing to the Study of Consumer Behavior. *Brazilian Business Review*, 11(3), 123-143. <https://doi.org/10.15728/bbr.2014.11.3.6>.
- Constantinescu, M., Orindaru, A., Pachitanu, A., Rosca, L., Caescu, S.C., & Orzan, M. C. (2019). Attitude Evaluation on Using the Neuromarketing Approach in Social Media: Matching Company's Purposes and Consumer's Benefits for Sustainable Business Growth. *Sustainability*, 11(24), 7094. <https://doi.org/10.3390/su11247094>.
- Dooley, R. (2010). *Baby pictures do really grab our attention*. <https://bit.ly/3g4c2Xo>.
- Dooley, R. (2011). *Brainfluence: 100 ways to persuade and convince consumers with Neuromarketing*. USA: Wiley.
- Dooley, R. (24 de febrero de 2015). *Neuromarketing: Pseudoscience no more*. <https://bit.ly/3g4n7ba>.
- Egidi, G., Nusbaum, H.C., & Cacioppo, J.T. (2008). Neuroeconomics: Foundational issues and consumer relevance. En Haugvedt, C., Kardes, F., y Herr, P. (Eds.), *Handbook of Consumer Psychology* (pp. 1177-1214). Mahwah, NJ: Erlbaum.
- Fisher, C. E., Chin, L., & Klitzman, R. (2010). Defining Neuromarketing: Practices and Professional Challenges. *Harvard Review of Psychiatry*, 18(4), 230-237. <https://doi.org/10.3109/10673229.2010.496623>.
- Fugate, D. L. (2008). Marketing services more effectively with neuromarketing research: a look into the future. *Journal of Services Marketing*, 22(2), 170-173. <https://doi.org/10.1108/08876040810862903>.
- Hazeldine, S. (2014). *Neuro-sell: How neuroscience can power your sales success*. UK: Kogan Page.
- Henrich, J., Heine, S.J., & Cnoretzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, 33, 61-135. <https://doi.org/10.1017/S0140525X0999152X>.
- Hensel, D., Iorga, A., Wolter, L., & Znanewitz, J. (2017). Conducting neuromarketing studies ethically-practitioner perspectives. *Cogent Psychology*, 4(1), 1320858. <https://doi.org/10.1080/23311908.2017.1320858>.
- Hilderbrand, M.L. (2016). *Neuromarketing: An essential tool in the future of advertising and brand development* [Tesis doctoral, University of Texas].
- Hsu, M. (2017). Neuromarketing: Inside the Mind of the Consumer. *California Management Review*, 59(4), 5-22. <https://doi.org/10.1177/0008125617720208>.
- Hubert, M., & Kenning, P. (2008). A current overview of consumer neuroscience. *Journal of Consumer Behaviour*, 7(4-5), 272-292. <https://doi.org/10.1002/cb.251>.
- Illes, J., Kirschen, M.P., Edwards, E., Stanford, L.R., Bandettini, P., Cho, M.K., Ford, P.J., Glover, G.H., Kulynych, J., Macklin, R., Michael, D.B. & Wolf, S.M. (2006). Ethics. Incidental findings in brain imaging research. *Science*, 311(5762), 783-784. <https://doi.org/10.1126/science.1124665>.
- Karmarkar, U.R., & Plassmann, H. (2019). Consumer Neuroscience: Past, Present, and Future. *Organizational Research Methods*, 22(1), 174-195. <https://doi.org/10.1177/1094428117730598>.

- Kenning, P.H., & Plassman, H. (2008). How neuroscience can inform consumer research. *Neural Systems and Rehabilitation Engineering, IEEE Transactions*, 16(6), 532-538. <https://doi.org/10.1109/TNSRE.2008.2009788>.
- Knutson, B., & Genevsky, A. (2018). Neuroforecasting Aggregate Choice. *Current Directions in Psychological Science*, 27(2), 110-115. <https://doi.org/10.1177/0963721417737877>.
- Krampe, C., Strelow, E., Haas, A., & Kenning, P. (2018). The application of mobile fNIRS to “shopper neuroscience” – first insights from a merchandising communication study. *European Journal of Marketing*, 52(1), 244-259. <https://doi.org/10.1108/EJM-12-2016-0727>.
- Lee, N., Chamberlain, L., & Brandes, L. (2018). Welcome to the jungle! The neuromarketing literature through the eyes of a newcomer. *European Journal of Marketing*, 52(1-2), 4–38. <https://doi.org/10.1108/EJM-02-2017-0122>.
- Lee, N., Broderick, A.J., & Chamberlain, L. (2007). What is neuromarketing? A discussion and agenda for future research. *International Journal of Psychophysiology*, 63(2), 199-204. <https://doi.org/10.1016/j.ijpsycho.2006.03.007>.
- Levy, M., & Weitz, B.A. (2009). *Retail Management*. New York: MacGraw-Hill.
- Lewis, D., & Bridger, D. (2005). *Market researchers make increasing use of Brain imaging*. <https://bit.ly/3gu5510>
- Lim, W.M. (2018). Demystifying Neuromarketing. *Journal of Business Research*, 91, 205-220. <https://doi.org/10.1016/j.jbusres.2018.05.036>.
- Lin, M., Cross, S., Jones, W., & Childers, T. L. (2018). Applying EEG in consumer neuroscience. *European Journal of Marketing*, 52(1), 66-91. <https://doi.org/10.1108/EJM-12-2016-0805>.
- Lindstrom, M. (2008). *Buyology: truth and lies about why we buy*. Australia: Random House.
- Lindstrom, M. (2010). *Buyology*. New York: Crown Publishing Group.
- Marichamy, K., & Sathiyavathi, J.K. (2014). Neuromarketing: The new science of consumer behavior. *Tactful Management Journal*, 2(6).
- McClure, S. M., Li, J., Tomlin, D., Cypert, K. S., Montague, L. M., & Montague, P. R. (2004). Neural Correlates of Behavioral Preference for Culturally Familiar Drinks. *Neuron*, 44(2), 379–387. <https://doi.org/10.1016/j.neuron.2004.09.019>.
- Monge Benito, S., & Fernández Guerra, V. (2012). Neuromarketing: Tecnologías, Mercado y Retos. *Pensar La Publicidad. Revista Internacional De Investigaciones Publicitarias*, 5(2), 19-42. [https://doi.org/10.5209/rev\\_PEP.2011.v5.n2.37862](https://doi.org/10.5209/rev_PEP.2011.v5.n2.37862).
- Mucha, T. (2005). This is your brain on advertising. *Business*, 6(7), 35-37.
- Murphy, E.R., Illes, J., & Reiner, P.B. (2008). Neuroethics of neuromarketing. *Journal of Consumer Behavior*, 7(4), 293-302. <https://doi.org/10.1002/cb.252>.
- Nave, G., Nadler, A., Dubois, D., Zava, D., Camerer, C., & Plassmann, H. (2018). Single-dose testosterone administration increases men’s preference for status goods. *Nature Communications*, 9, 2433. <https://doi.org/10.1038/s41467-018-04923-0>.
- Ohme, R., Reykowska, D., Weiner, D., & Choromansk, A. (2009). Analysis of neurophysiological reactions to advertising stimuli by means of EEG and Galvanic Skin Response measures. *Journal of Neuroscience, Psychology and Economics*, 2(1), 21-31. <https://doi.org/10.1037/a0015462>.
- Oliver, L (2016). *From exposure to purchase-Understanding the interaction of affect and cognition in consumer decision making* [Tesis doctoral, Hanken School of Economics].
- Orzan, G., Zara, I.A., & Purcarea, V.L. (2012). Neuromarketing techniques in pharmaceutical drugs advertising- A discussion and agenda for future research. *Journal of Medicine and Life*, 5(1), 428-432.



- Perrachione, T.K., & Perrachione, J.R. (2008). Brains and Brands: Developing mutually informative research in neuroscience and marketing. *Journal of Consumer Behavior*, 7(4), 303-318. <https://doi.org/10.1002/cb.253>.
- Plassmann, H., Ramsøy, T.Z., & Milosavljevic, M. (2012). Branding the brain: A critical review and outlook. *Journal of Consumer Psychology*, 22(1), 18-36. <https://doi.org/10.1016/j.jcps.2011.11.010>.
- Plassmann, H., Venkatraman, V., Huettel, S., & Yoon, C. (2015). Consumer Neuroscience: Applications, Challenges, and Possible Solutions. *Journal of Marketing Research*, 52(4), 427-435. <https://doi.org/10.1509/jmr.14.0048>.
- Plassmann, H., & Weber, B. (2015). Individual Differences in Marketing Placebo Effects: Evidence from Brain Imaging and Behavioral Experiments. *Journal of Marketing Research*, 52, 493-510. <https://doi.org/10.1509/jmr.13.0613>.
- Pop, C., Radomir, L., Ioana, M.A., & Maria, Z.M. (2009). Neuromarketing – Getting Inside The Customer'S Mind. *Annals of Faculty of Economics*, 4, 804-807.
- Pop, A.N., Dabija, D.C., & Iorga, A.M. (2014). Ethical responsibilities of neuromarketing companies in harnessing the market research - A global exploratory approach. *Amfiteatru Economic*, XVII(35), 26-40.
- Ramsøy, T.Z. (2014). *Introduction to Neuromarketing and Consumer Science*. Dinamarca: Neurons Inc.
- Riccio, A., Holz, E. M., Aricò, P., Leotta, F., Aloise, F., Desideri, L., Rimondini, M., Kübler, A., Mattia, D., & Cincotti, F. (2015). Hybrid P300-based brain-computer interface to improve usability for people with severe motor disability: Electromyographic signals for error correction during a spelling task. *Archives of Physical Medicine and Rehabilitation*, 96(3), S54-S61. <https://doi.org/10.1016/j.apmr.2014.05.029>.
- Rodrigues, F. (2011). *Influencia do Neuromarketing nos processos de tomada de decisao*. Viseu: Psicosma.
- Roebuck, K. (2011). *Neuromarketing: High-Impact strategies-What you need to know: Definitions, Adoptions, Impact, Benefits, Maturity, Vendors*. Brisbane: Emereo Publishing.
- Samuel, B.S., & Pransanth, V.T. (2012). Neuromarketing: Is Campbell in Soup? *IUP Journal of Marketing Management*, 11(2), 76-100.
- Sands, S. (octubre 2009). *Sample Size Analysis for Brainwave Collection (EEG) Methodologies*. <https://bit.ly/3zb3zjx>.
- Shiv, B., & Fedorikhin, A. (1999). Heart and Mind in Conflict: The interplay of affect and cognition in consumer decision making. *The Journal of Consumer Research*, 26(3), 278-292. <https://doi.org/10.1086/209563>.
- Sinek, S. (2009). *Start with Why: How great leaders inspire everyone to take action*. USA: Penguin Group.
- Smidts, A. (october 25 de 2002). *Kijken in het brein: Over de mogelijkheden van neuromarketing*. <http://hdl.handle.net/1765/308>.
- Solnais, C., Andreu-Perez, J., Sánchez-Fernández, J., & Andréu-Abela, J. (2013). The contribution of neuroscience to consumer research: A conceptual framework and empirical review. *Journal of Economic Psychology*, 36, 68-81. <https://doi.org/10.1016/j.joep.2013.02.011>.
- Stanton, S. J., Sinnott-Armstrong, W., & Huettel, S. A. (2017). Neuromarketing: Ethical Implications of its Use and Potential Misuse. *Journal of Business Ethics*, 144(4), 799-811. <https://doi.org/10.1007/s10551-016-3059-0>.
- Thompson, D. (16 de enero de 2013). *The irrational Consumer: Why Economics is dead wrong about how we make choices*. <https://bit.ly/2Smu91D>.

- Tovino, S.A. (2005). The confidentiality and privacy implications of functional magnetic resonance imaging. *The Journal of Law, Medicine & Ethics*, 33, 844–850. <https://doi.org/10.1111/j.1748-720X.2005.tb00550.x>.
- Yoon, C., Gonzales, R., Bechara, A., Berns, G., Dagher, A., Dubé, L., Huettel, S., Kable, J., Liberzon, I., Plassmann, H., Smidts, A., & Spence, C. (2012). Decision neuroscience and consumer decision-making. *Marketing Letters*, 23(2), 473–485. <https://doi.org/10.1007/s11002-012-9188-z>.
- Zajonc, R. (1980). Feeling and Thinking: Preferences need no inferences. *American Psychologist*, 35(2), 151-175. <https://doi.org/10.1037/0003-066X.35.2.151>.