


Cognitive science and neuromarketing: academic research, emerging technologies and professional challenges

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Emergentes e Desafios Profissionais

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Abstract

To analyze the efficiency of the messages produced by advertisers is the first step for establishing whether or not they are reaching the communication objectives which they have set out. Each person, on a daily basis, is met with thousands of persuasive messages and, for decades, a wide variety of measuring techniques have been used, the main limitation of which is their dependence on the will and ability of consumers to describe their level of attention, emotions, preferences and future buying behaviour. The end of the 20th century witnessed the birth of a paradigm which provided new methods for going more in-depth and furthering knowledge of persuasion mechanisms, particularly those related to the emotional aspects of the story, and how they affect our cognitive changes. This paradigm, applied to the field of marketing, implies an adaptation of neuroscience techniques to those of marketing communication, leading to neuromarketing. The aim of this piece of work is to study this discipline in greater depth - a discipline which, despite coming into existence barely two decades ago, already boasts a extensive scientific corpus, founded on empirical research studies.

Keywords: Neuromarketing; Advertising; Persuasion; Emotions; Advertising research; Consumer neuroscience; Neurocommunication

Resumen

Analizar la eficacia de las comunicaciones que llevan a cabo los anunciantes es el primer paso para conocer si se están alcanzando los objetivos de comunicación previstos. Cada persona se enfrenta, diariamente, a miles de mensajes persuasivos y, durante décadas, se ha utilizado una gran variedad de técnicas de medición cuya principal limitación es su dependencia de la voluntad y capacidad de los consumidores para describir sus niveles de atención, emociones, preferencias y futuros comportamientos de compra. Es a finales del siglo XX cuando nace un paradigma que aporta nuevos métodos para profundizar y avanzar en el conocimiento de los mecanismos de la persuasión, especialmente en aquellos relacionados con la influencia de los aspectos emocionales del relato, y en cómo contribuyen en nuestros cambios cognitivos; este paradigma, aplicado al ámbito de la mercadotecnia, implica adaptar las técnicas de la neurociencia a las comunicaciones de marketing, dando lugar al neuromarketing. El objetivo de este monográfico es profundizar en el conocimiento de esta disciplina que, a pesar de contar con poco más de dos décadas de historia, dispone ya de un extenso *corpus* científico fundamentado en investigaciones empíricas.

Palabras clave: Neuromarketing; Publicidad; Persuasión; Emociones; Investigación publicitaria; Neurocomunicación

Resumo

Analisar a eficácia das comunicações realizadas pelos anunciantes é o primeiro passo para saber se os objetivos de comunicação pretendidos estão a ser alcançados. Cada pessoa enfrenta, diariamente, milhares de mensagens persuasivas e, durante décadas, uma grande variedade de técnicas de medição têm sido utilizadas cuja principal limitação é a sua dependência da vontade e capacidade dos consumidores de descrever os seus níveis de atenção, emoções, preferências e comportamentos de compra futura. É no final do século XX que nasce um paradigma que fornece novos métodos para aprofundar e avançar no conhecimento dos mecanismos de persuasão, especialmente nos relacionados com a influência dos aspetos emocionais da história, e como contribuem para as nossas mudanças cognitivas; este paradigma, aplicado no campo do marketing,

passa por adaptar as técnicas da neurociência às comunicações de marketing, dando origem ao neuromarketing. O objetivo desta monografia é aprofundar o conhecimento desta disciplina que, apesar de ter pouco mais de duas décadas de história, já tem um extenso corpus científico baseado na investigação empírica.

Palavras-chave: Neuromarketing; Publicidade; Persuasão; Emoções; Pesquisa de publicidade; Pesquisador neurociência; Neurocomunicação

Introduction

Morin and Renvoise (2020), in their book *"The Persuasion Code"*, ask the following question after all the effort invested in creating persuasive messages: "have you ever asked yourself how effective all those attempts are from the point of view of people's brains? (...) can you switch in the "purchase button" in the brain of your target public?" (p. 11).

It is an interesting question which, in reality, is asked continually in the world of sales communication. Being able to measure the impact of the campaigns which advertisers carry out is a must in order to find out whether or not they are reaching their communication targets. Researching advertising efficiency, using more or less formal techniques or tools has, historically, been one of the activities associated with this type of campaign. Research into advertising messages has been carried out since the 19th century and, by the middle of the 20th century, basic tools were available for researching the effects on consumers. For decades, these tools have been included in methodological designs because "in essence, research is still based on the tools which were used in the 1960s since all breakthroughs have been aimed at optimizing research itself" (Pérez Pérez, 2019, p. 14), at least until neuroscience techniques began to be applied in the field of marketing communication, leading us to what we now know as neuromarketing.

Miller and Levin (2009) correctly state that persuasion implies an intentional communicative act which, in order to be successful must, at least, generate some type of cognitive, affective or behavioural modification in the receiver. One of the most reliable ways of persuading someone is by personalizing the messages for a specific audience. That is something which, although it was used in classical Greece, in modern days technology makes it relatively easy to achieve (Teeny, Siev, Briñol, Petty, 2021). Even though there are different ways of personalizing messages, Teeny et al. (2021) consider the most common form of personalized correspondence is that which links the content of the message and the receiver, which means knowing the public we address in order to create messages adapted to their characteristics. Two of the best ways of persuading are to personalize the messages for specific emotional states and to match the content of the message with consumers' personality traits.

Within this context, it should be borne in mind that “personality” refers to an individual’s unique and stable way of thinking and acting which distinguishes them from other individuals. One of the most important components of personality is “emotion”, as revealed by the different theories of personality: the three factors of Eysenck (Eysenck, 1994), the 16 factors of Cattell (Cattell, Boyle y Chant, 2002), the *Big Five* of McCrae and Costa (1991) or the seven factors of Tellegen and Waller (Waller et al.,1991). On the other hand, there is also a considerable body of experiments which demonstrate the personality’s ability to explain and predict emotions, to a large extent (Segerstrom and Smith, 2019). It must be remembered, too, that different studies reveal a link between unconscious processes, personality traits and decision-making (Abadie & Waroquier, 2019; Dell’Orco *et al.*, 2019; Myrica, 2019).

The use of neuromarketing techniques when researching the messages produced by advertisers is, precisely, in order to better understand the underlying mechanisms in consumer behaviour, purchasing decisions and, ultimately, to research the nature of persuasion.

Persuasion and efficiency in communication

Since the beginnings of western culture, as far back as ancient Greece, there has always been a significant interest in discovering the persuasive mechanisms of communication. *Peithó* is the name of a Greek goddess who, from the 5th century BC, represented persuasion in Athens from a double perspective: erotic and political. On the one hand, she was one of the goddesses of the entourage of the seductress, Aphrodite and, at the same time, the personification of a series of civic virtues related to the ability to persuade, such as trust or agreement - both of which are essential for the progress of democratic institutions (Atienza, 2013, p. 11). The importance of freedom of opinion in the democratic systems of government of Greek city-states serves to explain the numerous reflections of those thinkers who were aware of the relevance of the phenomenon of persuasion, its power and the ethical use thereof.

As opposed to other lines of thought which, over the centuries, considered persuasion to be an art form, Aristotle in his work “Rhetoric” took on his study in an analytical way, defining the principles of persuasion by means of empirical observation and identifying the three factors to which the speaker must pay attention: *ethos*, *pathos* and *logos*. *Ethos* could be identified with the charisma and credibility of the speaker, *pathos* with the audience’s emotional state - a skill which, to use modern terminology could be called “empathy” or “emotional intelligence” and, finally, *logos* is related to the intellect and reason, being identified with the audience’s ability to process information. In an ideal and rational situation, the *logos* comes to the fore in the discourse, whereas, in an imperfect, irrational reality, the *ethos* and *pathos* are dominant (Braet, 1992).

The Aristotelian influence in studies about the efficiency of messages has persisted throughout the history of western culture and is still valid in today's complex society through the different currents of neo-rhetoric. Naturally, this influence is also found in advertising. Rey and Fernández Gómez (2010) state that one of the most important persuasive tools, if not *the* most important, which professionals have at their disposal when making advertisements, is rhetoric. Moliné (2003), the famous and renowned advertiser goes one step further stating that the "advertising process is a rhetorical process. Since its beginnings, rhetoric has provided the character and spirit for our profession" (Moliné, 2003, p. 250). In addition, rhetoric and advertising place viewers, or the target audience, at the centre of the whole process, which means that they must be known beforehand in order to guarantee the success of the claims.

As an example of this influence, we can consider the research carried out by Romanova and Smirnova (2019) in which they analyse techniques of persuasion used in commercial advertising, classifying techniques in three groups depending on which principle of reasoning is used: those considered logical reasoning (*logos*), those that give a positive image of the company (*ethos*) and the ones that involve an emotional component (*pathos*). Having said that, during the persuasive interaction, in order to reach the objectives set out it is more efficient to combine techniques to maintain the balance of the three components - *ethos*, *logos* or *pathos* - and also to have an in-depth knowledge of publics.

The theories of neo-classical economics about *homo economicus*, build an advertising paradigm based on the rationality of the consumer and the thinking of behaviourist psychology. The birth of modern advertising, which is rationalist in nature, sought to perfect the professional techniques giving them a scientific nature and enabling them to design models of communication which go beyond intuition or creative genius.

Research at Yale, registered in the work known as the theory of learning is based on an ambitious project to discover general laws of persuasion and the work led to a greater understanding of persuasion, inspiring later research into it (Jowett & O'Donnell, 1992, p.133). It appeared as a consequence of the need to know and take advantage of the clear persuasive influence of mass media communication, in particular, in two fields - politics and sales. At the beginning of the 1950s, Hovland, Janis and Kelley specified that the persuasive impact depended upon three successive processes: attention, understanding and acceptance. The features which would be conducive to the acceptance of persuasive messages would be: the source of the message, the characteristics of the message, the features of the receiver, and the context of the message. In other words, who said what, to whom and with what effect? (Hovland, Janis and Kelly, 1953). Undoubtedly, a significant parallel can be drawn with Aristotelian theory.

But, what really is persuasion? Demirdögen (2010) states that persuasion can be defined as the principles and processes by which people's attitudes and behaviour are formed or modified, as a consequence of the attempts of others to influence them.

Focusing more on the area of advertising communication, O'Shaughnessy and O'Shaughnessy (2004) define persuasion as a process which seeks to alter, modify or change the relevance of the values, desires, beliefs and actions of others - and all social life is dominated by conscious, unconscious, direct or tangential attempts at persuasion. They also add that effective advertising is, normally, persuasive advertising and if it is not attempting to persuade, it is missing an opportunity since, in a situation of competition, those who are more likely to win are the ones who persuade best. That is why persuasion has always been important and even more so in a complex scenario which we face nowadays.

Perloff (2003), brings together the strengths of a series of definitions to establish that persuasion is a symbolic process in which communicators seek to convince other people to change their attitude or behaviour with regards one particular issue by means of a message, in a context of free choice. He highlights five components of the definition: persuasion is a process which requires time, a series of steps and actively engages the receiver of the message; persuasion implies an attempt at influencing, persuasive messages, even when they do not reach their targets, imply a deliberate attempt at influencing another person; people convince themselves, communicators provide the arguments but we are the ones who decide whether or not to change; persuasion implies the transfer of a message which is either personal or impersonal, verbal or non-verbal, personal or via the media, rational or irrational, factual or emotional, persuasion is an activity in communication in which there must be a message for it to take place. Finally, persuasion requires freedom of choice - the individual must be free to modify or not their own behaviour in a communication scenario.

In addition to the content and organization of the message, in advertising communication it is also very important to assess the influence of the context and medium used for communicating. Each means of communication has its own particular features and the message which seeks to persuade the audience must be adapted to it. There are media which are more efficient for activating the systematic processing of information transfer, whereas others favour heuristic processing. For decades, the influence of these features in the efficiency of advertising messages has been researched. So, in 1993, Deaux et al., concluded that a written message tends to be more efficient for the transfer of information which is difficult to memorize or requires a high level of attention, whereas, audiovisual or personal direct communication, tends to trigger heuristic processing. Almost two decades before, in 1976, Chaiken and Eagly demonstrated that the audiovisual medium required simple messages and provoked a greater change of attitude than audios and, at the same time, this format was more efficient than writing when it came to simple messages. This analysis is more important than ever, given that changes in technology and the onslaught of the Internet have caused a revolution in the media and, consequently, a challenge for advertisers' strategies "due to the rapid multiplication of the media through which individuals may be reached with commercial messages" (Martín García and Ávila Rodríguez de Mier, 2020, p. 208).

We have already spoken about how rhetoric and advertising place the audience or target public at the centre of the whole process. We now go back to that idea, given its importance for the efficiency of marketing communication. It was from the second half of the last century on, coinciding with the change in focus from the product to a new approach which placed the consumer at the centre of advertising communication, that a new line of thought was developed, incorporating new parameters, known as “motivational studies”. Authors such as Dichter, Martineua, Cheskin or Mitchel became the seed for the declaration of widespread and influential new ideas, for example, Maslow’s hierarchy of needs (Fernández Gómez, 2014, p. 75). Martineau, in 1957, summed it up in the phrase “We will get nowhere if we are content with formulating a logical truth for” (p. 23), the value acquired by the use of aesthetic effects and proposals based on emotional appeals to design messages which generate meanings in the non-rational part of the consumer.

When we appeal to the rationality of the receiver, the message is based on data and arguments to obtain the desired effect. The effects of rational communication have been studied in great detail, in particular those related to the presentation of evidence (McCroskey, 1969). However, the effectiveness of evidence depends on the ability and willingness of the receiver to process its content (Petty y Cacioppo, 1986). In many contexts, when these are reduced, the emotional, persuasive appeal of humour or fear are often used.

The fundamental principle of research into the effects of communication is justified by observation and the possibility of asking people questions which are taken as true. It can be said that during the 1970s, thanks to the gathering of quantitative data, the application of statistics and qualitative research techniques, the guidelines were established for research into the efficiency of messages and how they affected individuals’ decision-making and influenced their perception of reality. However, the limitations of verbal expression and unawareness of how we really feel sometimes make it difficult to understand even our own emotions. “Social psychologists continue to explore the ways in which we are unaware of what really makes up our behaviour and, to what extent, that contradicts the image we have of ourselves” (Graves, 2011, p. 41).

Since the end of the 20th century we have witnessed the birth of a paradigm which attempts to bring a new approach that develops knowledge of persuasion mechanisms, in particular, those which are related to the influence of the emotional aspects of the story, and how they contribute to our cognitive changes. To be more precise, there is a new line of research which uses new methods to go into more depth in the knowledge of the human mind. This paradigm, applied to the field of marketing, constitutes what is known as “neuromarketing” and, essentially, is the integration of several disciplines: psychology, neurology, economics and the theory of communication. Therefore, any suggested definition of neuromarketing must count on methods, techniques and the theoretical foundations of these disciplines, in addition to the contributions of neuroscience.

Neuromarketing as an area of research

The breakthroughs in neuroscience provide, among other things, two relevant aspects for all analysis related to communication and information processes in the field of consumer behaviour. The first relates to its contribution to a greater understanding of the means of accessing information which makes it possible to enrich knowledge about our conduct. The second, with deeper connotations, deals with a new concept of the human being.

Regarding the latter, neurosciences set out hypotheses which, if proven, would modify ideas about learning, the ways in which information is accessed or the processes involved in the building of knowledge and intelligence. The brain operates on the basis of interactions and relations rather than a command centre which controls all operations - meaning is established by means of reticular relations which respond to external demands. Information and knowledge are only developed and implanted when accompanied by an ability to be used. What we call "conscience" has nothing to do with a linear, rigorous or sequential mono-discourse but, rather, with a complex, multi-purpose system. Conscience would essentially be a reconstruction, an interpretation based on a world of ideas, hypotheses and suggestions which interact, unconsciously, in our mind (Álvarez, 2007, pp. 380-382). From Descartes's "I think therefore I am" to Antonio Damasio's "I am therefore I think".

Neuromarketing is an approach to understanding the factors or mechanisms which affect any process of communication and the effects it produces in our decisions and attitudes. It identifies two types of conscious and unconscious communicative stimuli. The model of Genco et al. (2013) determines four phases in the creation of our thought:

- a) Impression-forming with the information received by the senses and produced consciously, but with no conscious access to the way in which our mind perceives it.
- b) Determining meaning and value, by giving these impressions a meaning or relevance using rapid mental connections with our memory, which are also outside our awareness.
- c) Reflection and analysis, using conversations with ourselves. Most of the processes in this phase are conscious.
- d) Speaking and acting. Our way of expressing and behaving may be observed by ourselves and others.

In order to explain consumer behaviour, neuromarketing uses three essential variables: attention, emotion and memory. Subjects may be aware of whether or not they pay attention and, also, their memories or emotions. However, the motive which gives rise to these processes may be conscious or unconscious (Cabello, et al., 2020, p.21).

Emotion may be measured using the feelings it provokes when we refer to conscious emotional experiences. However, how can those unconscious emotional phenomena which play such a determinant role in our decision-making be explained? Neuromarketing

suggests there are two paths of action in the process of attention: the fast path and the slow path. In the first, the senses send the stimuli received to the amygdala where they are processed and registered, obtaining an automatic result. On the slow path, after an interval of a quarter of a second, the information reaches the brain cortex, it is adapted to the real environment and a rational reply is generated (Braidot, 2009).

The hypothesis of the somatic marker of the neuroscientist, Antonio Damasio, suggests that without emotions or with a defective functioning of the emotive system, it is impossible to make sensible and instrumentally rational decisions (Damasio, 1994). We take emotions to mean those causal processes which involve assessments, bodily changes and sensations - either innate or acquired (Pineda, 2019, p. 258). If the hypothesis is correct, rational decision-making is only viable with the help of the emotions, which can be recorded phenomenologically using the changes which our bodies undergo, most of them under the Autonomic Nervous System (ANS).

Finally, memory is made up of a bi-directional working; on the one hand, it codifies and stores memories and, at the same time, it allows their recovery. There are three types of memory which interact and communicate constantly with each other, explicitly and implicitly. Sensory memory, in charge of registering sensations; short-term memory, in charge of the information needed for the present; and long-term memory, which stores general knowledge (Atkinson y Shiffrin, 1968).

The studies of the psychologist Daniel Kahneman have revealed the existence of a double type of thought in human beings which he calls "fast" and "slow". Most of the decisions we take in our daily life are taken using fast thought, with a view to reducing the consumption of energy which any rigorous, rational intellectual effort requires. Both types of thinking are mixed in our day-to-day activities, interacting with each other constantly, without our being aware of it, and they determine our understanding of reality and our behaviour (Kahneman, 2012).

Contributions and limitations of neuromarketing techniques

Among the main aims of neuromarketing are the recording and measuring of sensations, emotions, and experiences, using technological tools. It seeks to provide solutions for hitherto unanswered questions using previous models. By way of illustration it is worth mentioning that the above-mentioned model from the School of Yale, with its clearly logical character, defines three phases in the process of message reception: attention, understanding and acceptance.

Nowadays it is common to see experiments carried out with neuroscience tools. As an example, eye-tracking devices allow us to access perception processes which are unconscious and, therefore, cannot be expressed verbally by subjects and are difficult to detect using direct observation. The use of neuromarketing techniques also makes it possible to establish the links between the emotions experienced by the public and the influence provoked in spontaneous and induced recall (Baraybar et al., 2018). Similarly, it aids the identification of the emotional impact on subjects when viewing the same message, depending on the format used, by recording the physiological changes and brain activity produced (Quiñones, 2022). Garaus, Wagner and Rainer (2021), using face-reading software at the point of sale, discovered that the emotional orientation increased purchasing decisions, the perceived quality of the product and readiness to pay. Rumpf and Breuer (2017) analyzed the results from different neuromarketing techniques and concluded that each of the techniques contributed to a deeper understanding of consumer behaviour in general and the reactions of the consumer to marketing stimuli in particular.

The application of these techniques generated high expectations at the beginning but they were also met with considerable suspicion and doubts of all types: ethical, legal, technology access, etc. Charles Spence (2019) sums up some of the criticism, limitations and challenges for neuromarketing techniques in an article entitled *Neuroscience-Inspired Design: From Academic Neuromarketing to Commercially Relevant Research*. The conclusion is that, despite the interest generated in the academic field, its incorporation in professional circles is yet to be consolidated.

Apart from the limitations highlighted by different authors, of the other reasons which may explain this reticence, there is the euphoria created by the false promise of being able to access the hidden thoughts in the minds of the public and the interest in everything applied and immediate - a common feature of the business side of the world of communication. Neurophysiological studies, themselves, have shown that our brain is evolving permanently in a constant transformation to adapt to its environment.

On the other hand, as with any scientific discipline, it is necessary to establish a solid, theory-based foundation to prevent reductionist or simplistic approaches. Any methodology has its limitation and neuromarketing is no exception, despite seeming to be a hard, laboratory-based science. In recent years, a scientific *corpus*, founded on empirical research has been created, and it has been shown that its use, together with that of traditional or conventional techniques, expands the knowledge of cognitive and information processes, among others, by making it possible to analyze implicit replies (Shen y Morris, 2016) (Baños-González et al., 2020).

Neuromarketing Tools

At the end of the 19th century, one of the fathers of modern psychology, William James, came up with one of the most influential theories regarding the nature of emotions. His central hypothesis is that an emotion is a conscious perception of the bodily changes associated with emotive events and, consequently, an emotion cannot be understood without specific bodily sensations. Emotions are phenomenological states, so much so that from the bodily changes recorded we will be able to identify the emotional state. A significant part of research into neuromarketing is carried out by measuring biometric variables which boast a base of theory and application which is linked to the tradition of psycho-physiology and makes it possible to measure psychological replies using biological or psychological parameters (Cuesta, 2021, p. 39). These techniques allow the analysis of implicit replies - those which are produced automatically and unconsciously - of subjects on viewing messages, and they also mean we can progress in our knowledge of the influence of emotions and related processes in the reception, comprehension and elaboration of information.

We can distinguish two types of technique used in neurocommunication: those which focus on the measuring of psycho-physiological variables, and those which are related to the consideration of neurological variables. In the first group, the most-used tools are:

Eye-tracking. This makes it possible to analyze the variables associated with attention, gaze path or the engagement of the subject with an image. Using infra-red rays, the movements of the pupil are detected and it is possible to quantify when and where the gaze stops and identify reading speed. Current *software* produces a rapid and comprehensible visualization of data and facilitates the creation of heat-maps and the analysis of areas of interest (AOI). At the same time, it is possible to measure the changes in pupils, dilatation and contraction, all of which is related to emotional excitement or attention, and the minimal variations in the distance of the subject from the screen.

On occasions, this technique may be used with aesthetic and creative ends. It can empirically determine the implicit behaviour of the spectator and allow a correlation with the author's intentions using the proposed composition (colour, contrast, make-up of elements or their positioning) and what the viewer's gaze really seeks as opposed to the intentions they express. Author of several books, the photographer Michael Freeman, who has expressed interest in the study of harmony and creative keys, has experimented with these techniques in order to identify the effectiveness of composition in some of his works.

In addition, on-going research makes it possible for us to explore new possibilities. As an illustration it is worth mentioning the possibility of detecting deceit. When we see a face we know in a group of strangers, a characteristic stare takes place for around 500 milliseconds. This occurs especially when faces are seen for the first time (Lancry-Dayana et al., 2018, Mahoney et al., 2018); but, even when the sample group has been trained for deceit, the

increase in the average duration of the stare for familiar faces is still significant, irrespective of the warnings or instructions received (Millen and Hancock, 2019). Linked to this field, other methods, which use eye-tracking to identify when subjects are hiding information in their replies to questions asked during interviews, have also been developed. They use parameters such as the increase of the dilatation of the pupil, the speed of blinking or the reduction in the number of looks (Walczyk et al., 2012, Peth et al., 2013). These replies can help detect the increase in physiological stress and the cognitive charge when lying.

The galvanic skin response (GSR). This is a measurement of electrodermal activity, specifically, the conductance of our skin by perspiration. Sweating is a totally autonomous operation which plays a fundamental role in the human body's thermoregulation, but also manifests itself as a bodily reaction to *peak arousal*. When measuring the level of perspiration, in stable atmospheric conditions, GSR seeks to become the evidence of a stimulated state which is beyond the person's deliberate control. Subtle and imperceptible changes can be registered self-consciously. At the same time, it provides a register of *heart rate variability* (HRV), which is important for detecting false emotional peaks.

Electrocardiograms (ECG). These register heart beats electronically and reveal the rhythm and strength of our heartbeats, which, as in the case of GSR, can be linked to evidence of physiological, emotional or psychological arousal. In both cases it is necessary to carry out a particular analysis of the conditions of each subject to prevent the bias which can always be produced in the heart activity of a person who feels they are being observed.

Facial action coding. This is a specific form of non-verbal language. It allows a detection of emotional states using conscious observable gestures, such as, a smile, and unconscious micro-gestures. One of the foremost researchers in this method is Dan Hill, who established 24 combinations of movements of the muscles which can be related to the seven basic emotions (Hill, 2010). Using a camera tracing of the movements of muscles, and specialized software, they can be compared with known patterns of gestures and associated with joy, sadness, fear, rage, hatred and disgust (Gill and Singh, 2020, p. 104). The studies carried out have identified possible discrepancies and difficulties in the recording of some expressions in order to link them to certain emotions according to some of the models which are regularly used. On the other hand, the lack of resolution or sharpness in the image or a deficiency in the illumination of the face of the subject may cause excess interference in the identification of micro-expressions.

The information gathered with the use of one type of tool is useful, however, in order to improve precision, it would appear to be recommendable to involve several techniques to achieve a multi-faceted interpretation of information. As such, the data obtained using GSR or ECG make it possible to perceive excitation but not whether it is positive or negative and, together with the facial expression, we can measure the valence of the emotion generated.

Of the neurological measuring tools, we can identify two types, depending on their difficulty of use, cost and how invasive they are with the persons who make up the sample group.

On the one hand, we have the **electroencephalogram (EEG)**. This is the most sophisticated technology of those which are used regularly. By placing sensors on the head, it measures the electrical activity of the cerebral cortex. The frequencies of emission in this zone are recorded, particularly the prefrontal part of the brain which is linked to experience and emotional expression, as well as the decision-making process. Using a series of algorithms, frequency is transformed into a series of emotional indicators, positive or pleasant stimuli and negative or unpleasant stimuli, and cognitive ones to measure the level of attention and the mental effort of decoding employed.

Three other neuroimaging tools, the application of which is reduced to the scientific and academic fields, and, exceptionally, for market research, are:

Functional magnetic resonance imaging, (fMRI). This is a research procedure which detects the level of blood in areas of the brain in response to sensorial, motor, cognitive or emotional activity. Neuronal activity causes metabolic changes in blood flow which are measured using the signal known as *BOLD (blood oxygenation level dependent)*. By this method, we obtain data from the different layers of the brain and can link the stimulation applied with the function of the brain zone which is activated. Of the advantages it offers, the most important is the access to deeper parts of the brain, such as the activation of the amygdala related to fear, or the accumbens nucleus, related to the sensation of pleasure (Martínez Rodríguez, 2021, p. 161).

Functional infrared spectroscopy, (fNIRS). Similar to the previous technique, it measures the absorption of the infra-red light signal in the haemoglobin of the blood with or without oxygen, thus recording the brain activity. Its greatest advantage over the previous method is found in the greatly reduced dimensions of the apparatus used, making it faster, cheaper and, above all, less intrusive for the subject. In real time, it is possible to observe the oxygenation of brain tissue and quantitatively record the functions of attention, memory and problem resolution while the person is carrying out a cognitive task.

Magnetoencephalography (MEG). This tool, which has limited functionality in the field of neuromarketing due to its costliness, detects the magnetic fields induced by the neural activity of the brain.

From a historical-cultural perspective of science, each generation receives a model of how to understand reality and, at the same time, attempts to apply, extend or transform that model. The field of communication is immersed in a clear transformation - new values, new behaviour and technologies which introduce new tools. Neurocommunication strives for a greater understanding of the workings of the mind, proposing new lines for assessing the emotional stimuli received and our unconscious behaviour. The journey which began

centuries ago in search of a better understanding of how messages can generate, confirm or modify our thoughts and behaviour, continues. To sum up, exploration takes place to gain a better comprehension of the processes related to the efficiency of messages and, in particular, to Aristotelian *pathos*.

Author Contributions

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