

# Consumer neuroscience on branding and packaging: A review and future research agenda

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## Abstract

In an environment of extreme competition, it is essential to have a differentiated brand that adds value to consumer communications through packaging. Neuroscience research techniques have undergone remarkable development, facilitating the understanding of consumer brain mechanisms in the choice and purchase decision-making process. This article presents the first systematic and specific literature review of the branding and packaging from the consumer neuroscience viewpoint. The main objective is to carry out analysis focused on the study of packaging and branding from the field of consumer neuroscience. We used a hybrid methodology. First, a descriptive bibliometric study is applied based on the Web of Science platform, where results confirm that the study field is in a phase of an exponential growth and with high fragmentation of the literature, consistent with its multidisciplinary origin. Using data mining for nodal network analysis with the VOSviewer programme, four clusters of authors and five thematic areas of interest were identified. Finally, a content review provided a list of more than 50 relevant findings in the study field, which are presented through a novel classification approach based on key mental processes in branding and packaging research (attention and memory, emotions and motivation, and reward and decision-making systems). Thus, it has been possible to classify, order and discuss them, facilitating a comparative analysis and suggesting a possible future research agenda. This research intends to be a guide for branding and packaging professionals and researchers who are interested in learning about the use of consumer neuroscience techniques and theories.

## KEYWORDS

branding, consumer behaviour, consumer neuroscience, consumer studies, neuromarketing, packaging

## 1 | INTRODUCTION

On numerous occasions during their careers, many marketing professionals have faced the process of developing new products and brands. Almost always they have raised the question: how to create the right brand and packaging design? As a key factor in the quality perception

for the consumer, the importance of branding and packaging is well known (Gómez et al., 2015; Reimann et al., 2010; Schafer, 2013). But, how can we objectively evaluate what really attracts and captivates the consumer? How to generate consumer engagement to the brand through packaging? And the final question: what are the underlying mechanisms for the consumer's ultimate decision?

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In a global environment of extreme competition such as the present one, it is essential to achieve brands and products differentiation through packaging that adds value to the final product and captures the consumer's attention. Various researchers have estimated that up to 95% of new brand launches fail (Nobel, 2011; Schneider & Hall, 2011). It is estimated that between 85% and 95% of decisions are made subconsciously (García Palomo, 2014) and within seconds (Milosavljevic, Koch, & Rangel, 2011; Milosavljevic, Navalpakkam, et al., 2011). Therefore, it is essential that the marketed product stands out from its competitors, as a consumer can pass by 300 different products per minute while browsing the shelves of a supermarket (Rundh, 2005). Additionally, it is estimated that 70% of purchase decisions in a supermarket are based on seeing a product's packaging (Cerantola, 2016). Understanding how the consumer perceives, evaluates, and chooses products, allow companies to optimize the packaging design and thus, adds a value that contributes to the brand's marketing strategies (Rundh, 2016).

In this context, branding is a term that comprises all the initiatives that surround the creation process and strategic management of a brand (Llamas, 2013). Branding seeks to be a sign of differentiation for the mark and an element to convey a meaning associated with the product, which ultimately becomes a promise of a satisfied consumer (Baños González & Rodríguez García, 2012). For Kotler (2016), building a brand means establishing and developing its purpose, which involves the process of engaging the emotional and affective part of the customer's mind. But, packaging is considered as one of the crucial expressions of product branding, which includes other variables, such as naming, logo, price, and other elements. Packaging is considered a product's calling card and is the essential part of a brand materialized in a reduced space (Gobé, 2001). The main goal of packaging is to create emotions, feelings, and perceptions in the consumer's mind and associate all this to the brand (Razak, 2020).

In addition, self-report techniques, such as focus groups and opinion surveys, have traditionally been used to evaluate branding and packaging, and their attributes that predict consumer decisions and behaviour. However, the interpretations of the findings based on the results obtained from focus groups are considered subjective and cannot provide numerical evidence for validating affirmations (Hurley et al., 2013). These methods are not very operative to measure deep emotions and pose difficulties in explaining consumer decision-making process (Sánchez-Fernández et al., 2021).

Therefore, the main objective of this research article is to carry out a systematic review of the scientific literature on the study of branding and packaging through the theories and techniques of consumer neuroscience. Thus, the aim is to develop advances in this research area based on the knowledge of previous studies and findings, by applying a synthesis and structuring of the information from a wide range of articles in order to provide some suggestions on a future research agenda. Previously, various studies had clarified some characteristics of consumer neuroscience tools (Casado-Aranda & Sanchez-Fernandez, 2022; Harris et al., 2018), developed systematic and bibliometric reviews for the general analysis of the neuromarketing (Alsharif et al., 2021; Solnais et al., 2013), advertising from the field of neuroscience (Lee et al., 2018; Sánchez-Fernández

et al., 2021), also more specifically on neuromarketing and food choices (Stasi et al., 2018), or neuroscience research in consumer behaviour and a future research agenda (Oliveira et al., 2022). However, this is the first paper that specifically addresses the research subdomain of branding and packaging from the perspective of consumer neuroscience. The insights obtained could be useful for branding and packaging practitioners and researchers from a neuromarketing perspective.

The article is divided in various sections. It starts with the theoretical background, then follows explanation of the applied methodological techniques and processes. The section of obtained results includes a summary of the main findings recorded in branding and packaging studies from the perspective of consumer neuroscience, classified according to the cognitive processes involved. The final part presents sections such as the discussion and a proposal of a possible future research agenda, as well as the final conclusions.

## 2 | THEORETICAL BACKGROUND

### 2.1 | Neuroscience branches in social and economic sciences

Scientific and technological advances in recent decades in the study of neuronal processes in the human brain have allowed the development of new and more precise tools to overcome some of the abovementioned limitations. Neuroscience helps to understand the role of internal emotional responses, which play an important role in economic decision-making process (Sanfey et al., 2003). In this sense, neuroscientific techniques provide objective physiological data as the subjects have very little influence on these measurements (Camerer et al., 2005). Furthermore, neuroscience techniques allow to track consumers' neural and biometric responses simultaneously with the marketing stimulus processing, thereby eliminating the risk of recall bias commonly associated with self-report measures (Sudman & Bradburn, 1973). Thus, neuroscience has a multidisciplinary approach with contributions from psychology, marketing, and economics, among others. Neuroscience and its tools also have been a great support to the social sciences. Its joint use makes facilitates the approach to aspects such as feelings, emotions, attention, social interaction, and ultimately, the decision-making mechanisms of individuals addressed from the cognitive-emotional neuroscience perspective. The purpose of all this, is to bring together knowledge from different fields, to analyse and debate, which issues should be addressed from one perspective or another, depending on what is to be achieved (Casas & Méndez, 2013).

#### 2.1.1 | Neuromarketing

In this context of multidisciplinary collaboration, the term 'Neuromarketing' arises. Apparently, this term was first proposed in 2002 by Professor Ale Smidts from the University of Rotterdam. He says that neuromarketing tries to better understand customers and their responses to marketing stimuli, directly measuring the processes in

the brain and involving them in the development of theories and stimuli (Smidts, 2002). Neuromarketing is often associated with the commercial use of neuroscience discoveries and its tools by companies to better understand their consumers. Genco et al. (2013) define neuromarketing as any marketing or market research activity that applies the methods and techniques of neuroscience. The authors mentioned above also stress that it is not a type of marketing but a new way of measuring how and in what way marketing actions are working. Although academic studies are based on strict protocols and are subject to a scientific approach involving the support of ethical committees (Spence et al., 2019), the validity of methods and metrics in business studies has been a crucial concern from the outset (Ramsay, 2019). This unfavourable reputation of the term 'neuromarketing' in the academic environment has favoured the development of alternative terms proposed by Spence, 'Academic Neuromarketing' and 'Commercial Neuromarketing' (Spence, 2019).

### 2.1.2 | Consumer neuroscience

Hubert and Kennig (2008) restrict neuromarketing to the practical implementation of the knowledge provided by consumer neuroscience for management purposes, promoting the term 'consumer neuroscience' as the ideal one to study and understand consumer psychology and behaviour. Ramsay (2015, pp. 5–6) defines 'consumer neuroscience' as a combination of the academic study of psychology and consumer behaviour involved in 'analysing, studying, interpreting, theorizing, and predicting the subject's behaviour in terms of individual's likelihood to exchange goods or services'.

### 2.1.3 | Cognitive neuroscience

Plasmann et al. (2012) consider it to fall within the discipline of cognitive-emotional neuroscience, whose objective is to study the interactions between products, markets, and consumers. Cognitive neuroscience aims to map mental processes into brain function (Poldrack et al., 2011). Meanwhile, Solnais et al. (2013) highlight that it is part of the broader field of decision neuroscience by focusing on the brain mechanisms involved in consumer decision-making processes.

### 2.1.4 | Neuroeconomía

Reimann et al. (2011) include it within the field of neuroeconomics and understand it as the study of the conditions and neural processes that underlie consumption, its psychological meaning, and its behavioural consequences. For Camerer et al. (2005), the objective of neuroeconomics is to better understand and predict economic decision-making in order to comprehend the foundations of dual process theory, an economic perspective, which suggests that human cognition can be viewed as the result of a 'higher' controlled mental process (called System 2) and a 'lower' heuristic process (called System 1).

### 2.1.5 | Neuromanagement

The term neuromanagement refers to the application of cognitive neuroscience techniques in the management and administration tasks of organizations, based on neurological processes for decision-making, personal and organizational intelligence, and human resources planning and management (Braidot, 2016). On the other hand, Genoni (2016) places it in the field of modern medicine, although he considers it as the application of neurosciences to the management of any type of organization, particularly in the business field.

A multidisciplinary origin of neuroscience has involved the application of its different techniques in various marketing disciplines, such as market research, marketing in general, the study of processes related to brands, memory and preferences (Esch et al., 2012; Reimann et al., 2011; Santos et al., 2011), study of packaging aesthetics and label design (Reimann et al., 2010; Retamosa Ferreira et al., 2021), examining specific stimuli related to colours and brightness (Itti & Koch, 2001; Milosavljevic, Koch, & Rangel, 2011; Milosavljevic, Navalpakkam, et al., 2011), or within the field of advertising and communication in consumer decision-making processes (Casado-Aranda et al., 2018; Daugherty et al., 2016), or within the study of emotional effectiveness on advertising (Otamendi & Sutil Martín, 2020), or online advertising (Gómez Carmona et al., 2021). This research has helped to understand advances in location of neurophysiological correlations with psychological constructs linked to consumer behaviour and decision-making, thus overcoming the dependence on subjective self-reports.

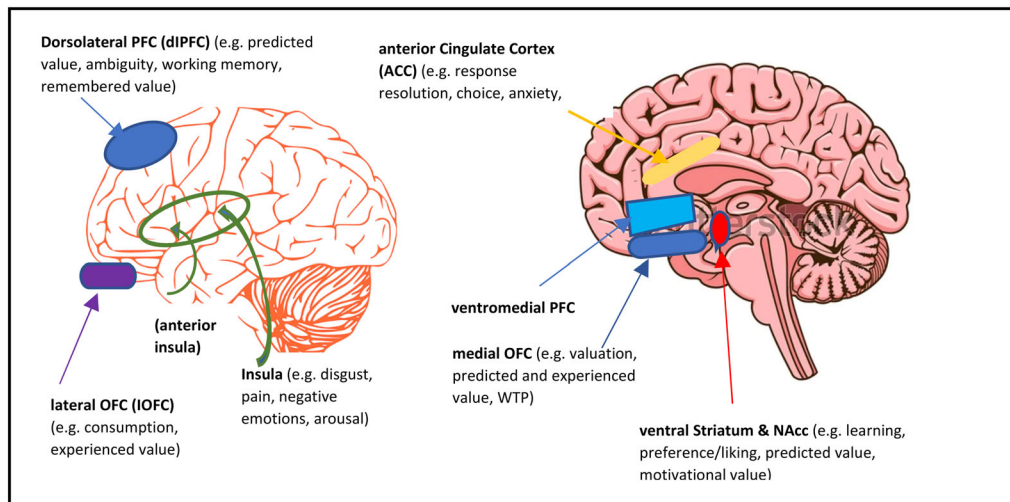
Consequently, it is considered as a cutting-edge approach for analysing decision-making processes in which irrational, intuitive, heuristic, and affective processes play a key role (Bechara et al., 2000; Dijksterhuis, 2004; Ohme et al., 2010).

## 2.2 | Cognitive processes and neural correlates

For Stasi et al. (2018), neuromarketing comprises a series of research techniques that can directly measure those aspects now considered crucial in the consumption process, such as attention, emotional response, and memory, in terms of storage of information. In order to establish a theoretical framework of key brain mechanisms, we will add the reward and decision-making systems (Plasmann et al., 2015; Solnais et al., 2013). Also, we summarize the principal neural correlates found in each of these processes. Figure 1 presents some of the most important brain regions in a consumer decision-making research.

### 2.2.1 | Attention and memory

The brain mechanisms involved in attention and visual processing are important for studying branding and packaging. Some authors estimate that around 90% of consumers choose a purchase option based on a visual examination of the packaging (Clement, 2007). The numerous components of packaging can be divided into two main groups:



**FIGURE 1** Essential brain areas for consumer decision-making research. Source: Adapted from Karmarkar & Plassmann (2019).

visual elements (logos, designs, colours, images, shapes, and size) and verbal components, which are textual information and specific characteristics, such as producer, country of origin, or materials (García-Madariaga et al., 2018). Thus, the prefrontal cortex is responsible for directing and focusing attention to the brain vision centre in the occipital lobe (Armstrong et al., 2006). The study of mental processes related to memory is essential in brand and/or packaging recognition, and the experience obtained from the product itself. Also, the hippocampus (in the temporal lobe) is a key region for processing and long-term memory consolidation (McGaugh, 2000), and for acquisition and recall in declarative memory (Eichenbaum, 2000). Additionally, the amygdala plays a vital role in memory consolidation (McGaugh, 2000).

## 2.2.2 | Emotions

The amygdala is an important part of creating the consumer's emotional responses, intervening in processing negative emotions, unknown stimuli, and aversive responses to injustice (Rilling & Sanfey, 2011), fear and aversive memory (Maren & Quirk, 2004). Similarly, the amygdala has been found to process positive emotions in relation to rewarding stimuli (Murray, 2007). On the other hand, the insula was involved with negative or risky expectations, especially social or financial (Knutson & Bossaerts, 2007; Preuschoff et al., 2008), and its activation has also been associated with anger and disgust in response to unfair economic situations (Sanfey et al., 2003). The orbitofrontal cortex (OFC) is involved in experiencing and anticipating the emotions of regret when outcomes differ from expectations (Coricelli et al., 2005). Finally, we must refer to the anterior cingulate (cingulate gyrus) that evaluates emotional and motivational information and integrates it into the decision-making process (Bush et al., 2000). Likewise, it has been associated with the experience of an internal conflict between alternative options and its activation may be due to a conflict between cognitive and emotional motivations (Sanfey et al., 2003). In any case, the complexity of the

interconnected brain networks involved in emotions must be considered, as there is no single brain region responsible for emotional processes and activated in relation to a particular type of emotion (Phan et al., 2002).

## 2.2.3 | Motivation approach and avoidance systems

Neuroscience literature synthesizes motivational systems of the individual's behaviour in two ways: an anticipated desirable result (approach) and a possible adverse result (avoidance). By studying brain waves, it has been possible to provide empirical evidence that the left frontal cortex is involved in the approach system, whereas the right frontal cortex is involved in the avoidance system (Davidson, 2004). If the activation balance is favourable to the left frontal region, associated with the approach system, it is generally linked to positive emotions, and if the balance favours the right frontal region, it is associated with the avoidance system and it is linked to negative emotions. However, these confirmations should be viewed with caution, as this is not always the case (Harmon-Jones, 2003). Therefore, the results of these studies' give us the possibility to monitor the left-right asymmetry and to infer the potential attractiveness of the packaging or any other marketing stimuli.

## 2.2.4 | Reward systems

An attractive packaging design of a favourite brand can act as a rewarding stimulus within the consumer's brain and trigger the psychological motivations that influence purchasing behaviour. This has been reported in studies with subjectively attractive rewards like food (Berridge, 1996), money (Knutson et al., 2001), and drugs (Wise & Rompré, 1989). Although an important function of the striatum is movement planning and control, it also plays a notable role in the brain's reward system. There is evidence that the striatum and its

components (putamen, caudate nucleus, and nucleus accumbent [Nacc]) participate in evaluating actual rewards related to someone's expectations (Knutson & Wimmer, 2007) and the influence of social factors on reward-related activity (Fließbach et al., 2007). The ventral tegmental area is also a part of the reward system, which is responsible for transmitting dopamine to other brain regions by allowing modulation of decision-making and playing a role in goal-seeking behaviours (Campos et al., 2007).

### 2.2.5 | Decision-making

The way in which consumers evaluate different packaging alternatives and make their decisions based on the perceived cost/benefit ratio is a crucial aspect for consideration. There is evidence that both the (OFC) and the ventromedial prefrontal cortex (VMPFC) are involved in processing different alternatives and potential outcomes through the evaluation of perceived value (Daw et al., 2006; Tremblay & Schultz, 1999). The OFC is associated with the evaluation of compensations and the expected result ability to satisfy someone's needs (Wallis, 2007), and plays a central role in a decision-making process, especially in unpredictable situations (Elliott et al., 2000). The dorsolateral prefrontal cortex (DLPFC) likewise plays a relevant role in decision-making, as its participation in the cognitive control of emotions has been recognized (Rilling et al., 2008). Particularly, it is involved in impulse control to comply with social norms, while the ventrolateral prefrontal cortex (VLPFC) is important in motivating social norm compliance by enacting the threat of punishment from others (Rilling & Sanfey, 2011). However, the cognitive effort in the PFC seems to be lower, when a certain gain is expected compared with risky decisions (González et al., 2005). Therefore, measuring the activity of these regions can provide useful insights into the neural underpinnings of consumer choices and marketing constructs, such as perceived value.

These cognitive processes are closely related to each other, but highlighting some of them does not necessarily imply the selection of the final product (e.g., a luxury item can effectively attract our attention and impact us emotionally, but in the expected cost/benefit balance its high price can negatively influence our decision-making). Therefore, the independent measurement of just one of these processes could not be understood as a reliable parameter to predict packaging preferences.

Table 1 presents a summary of the most used neurophysiological and biometric techniques and tools, which in the scientific literature are mostly associated with branding and packaging studies. Also, Stasi et al. (2018) and Casado-Aranda and Sanchez-Fernandez (2022) present an in-depth analysis of neuroscience research tools and their current contribution to consumer neuroscience in market research.

## 3 | METHODOLOGY

From the methodological viewpoint, this article follows various phases applying different scientific techniques. As a first step for studying the

branding and packaging research from the perspective of neuromarketing, a systematic review was applied (Figure 2). A systematic review can be classified into different categories (Paul & Criado, 2020).

The methodology applied in this article is based on a mixed approach of bibliometrics and relational analysis of nodal networks carried out through the VOSviewer tool (v1.6.15.), the objective of which 'is to create maps based on network data' (Van Eck & Waltman, 2020, p. 5), based on publications, researchers, keywords, or terms. Elements of these networks can be connected through co-authorship, co-citation, bibliographic coupling, or co-occurrence links. A bibliometric analysis consists of 'the quantitative study of published physical units or bibliographic units' (Broadus, 1987, p. 376). This kind of analysis makes easier to understand and evaluate the scientific production available on the studied topic and the different fields of research explored by the academic community. Data obtained from the bibliometric analysis are essential for evaluating the intensity and orientation of new research areas (Bartoli & Medvet, 2014; Gaviria-Marin et al., 2019), but does not analyse the textual information within each article. Using a text-mining approach, such information can be structured and grouped into different topics by extracting useful information from a large collection of data semi-automatically adding valuable context to a quantitative analysis. This technique gives structure to the data and allows the relational statistical analysis of the recovered data (Moro et al., 2017). A hybrid approach between these two techniques can lead to much deeper results (Paul et al., 2021). Hence, the construction of bibliometric maps is a resource of interest and is frequently used in models (Gregorio-Chaviano et al., 2020).

As an initial phase of this article, a bibliometric analysis was carried out by using WoS platform, including publications until 31 December 2020, under the topics 'branding' or 'packaging'. In a preliminary search under these parameters, up to 862,468 records were found, revealing a great interest in the study area. In order to know the general evolution of the investigated field, other topics were added in relation to the neuroscience field, such as 'Neuromarketing', 'Neuroscience', 'Consumer Behaviour', and 'Branding and Packaging' from the initial records on the platform (the first registered publication dates back to 1945) until 31 December 2020. By applying Price's Law to the obtained results (Price, 1963) it was confirmed that the research field is in a phase of an exponential growth (Figure 3a). However, if this same analysis is applied to the evolution of publications made exclusively under the topics 'Branding or Packaging', it shows a linear growth trend, even registering a notable decrease in 2009 (Figure 3b). Thus, it can be concluded that the inclusion of the neuroscientific research perspective in a consolidated field, such as branding and packaging studies, has strongly boosted their research.

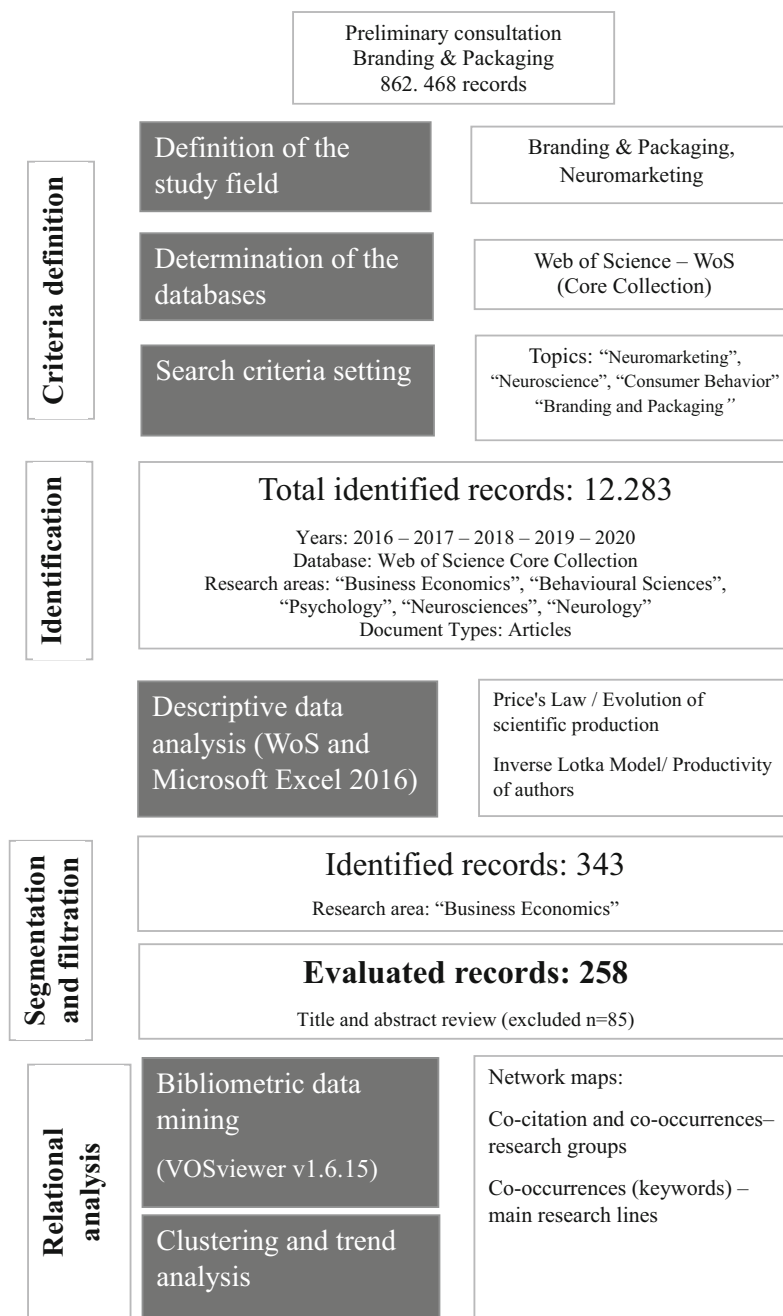
In this context, the authors decided that for the descriptive analysis, the most recent trends between 2016 and 2020 will be applied, with the topics mentioned above. Also, by deepening the analysis process, the filters were refined in research areas, such as 'Business Economics', 'Behavioural Sciences', 'Psychology', 'Neurosciences', and 'Neurology' in the database 'Web of Science Core Collection', 'Open



**TABLE 1** Most used consumer neuroscience techniques in neuromarketing.

Tool/type	Relevant uses	Advantages	Disadvantages	Measurement
Electroencephalography (EEG) and magnetoencephalography Neurological	<ul style="list-style-type: none"> <li>• Common in applied research in neuromarketing</li> <li>• Monitor experience in stores and social environments</li> <li>• Detection of positive/negative arousal, conflict in decision-making, attention, language processing, some effects on memory</li> </ul>	<ul style="list-style-type: none"> <li>• Minimally invasive, low cost and easy to apply</li> <li>• High temporal resolution</li> <li>• Availability of commercial research packages</li> <li>• Allows the movement and participation of subjects in activities in the social environment</li> </ul>	<ul style="list-style-type: none"> <li>• Poor spatial resolution</li> <li>• Temporal resolution depends on the hardware used</li> <li>• It does not allow to measure activity of deep brain structures</li> </ul>	<ul style="list-style-type: none"> <li>• Electrical brain activity through the multiple electrodes placed on the scalp, revealing electrical signals of cortical brain areas</li> <li>• Used to measure rapid changes in neural activity on a millisecond scale</li> </ul>
Functional magnetic resonance imaging (fMRI) Neurological	<ul style="list-style-type: none"> <li>• Localization of the neural process during decision-making, consumer experiences, socially relevant stimuli and learning values</li> <li>• Measures response to marketing stimuli such as brand and price</li> <li>• Prediction of the behaviour at the market level</li> </ul>	<ul style="list-style-type: none"> <li>• Non-invasive technique with high spatial resolution (up to 1 cm<sup>3</sup>)</li> <li>• Differentiation of the signal from neighbouring areas</li> <li>• The most widely used in the academic environment, excellent information report;</li> </ul>	<ul style="list-style-type: none"> <li>• Very expensive, complex equipment and operates in a very artificial environment</li> <li>• Restricts the participant's physical movements</li> <li>• Limited temporal resolution</li> </ul>	<ul style="list-style-type: none"> <li>• Measurement of the whole brain and ability to detect activity in small structures</li> <li>• Neural activity by changes in blood oxygenation (blood flow) during cognitive tasks</li> </ul>
Functional near-infrared spectroscopy Neurological	<ul style="list-style-type: none"> <li>• Monitoring of prefrontal cortex areas—advertising preferences, branding, and packaging</li> <li>• Prediction of decision-making behaviour</li> </ul>	<ul style="list-style-type: none"> <li>• Non-invasive technique with high spatial resolution (up to 2 cm)</li> </ul>	<ul style="list-style-type: none"> <li>• Recent development of the technique, requires experience</li> <li>• Limited temporal resolution</li> </ul>	<ul style="list-style-type: none"> <li>• Optical imaging technique that records changes in the flow of haemoglobin (Hb)</li> </ul>
Eye tracking Biometric	<ul style="list-style-type: none"> <li>• Analysis of the shelves, packaging, and advertising</li> <li>• Analysis usability of websites</li> <li>• Can be used to record attention and search for information in scenes of interpersonal communication</li> <li>• Relevance in research in digital media and high weight in packaging studies</li> </ul>	<ul style="list-style-type: none"> <li>• Analysis facilitated by heatmaps</li> <li>• Available mechanisms (Tobii) that favour the mobility of the subject in a more natural environment</li> <li>• Easily combinable with other techniques, such as EEG and MRI</li> </ul>	<ul style="list-style-type: none"> <li>• Does not measure inferences, response valence, thoughts, or emotions</li> <li>• Requires experience for its application and knowledge in the use and interpretation of the software</li> </ul>	<ul style="list-style-type: none"> <li>• Manifests attention tracking</li> <li>• The most common measurements include the speed and direction of eye movement, fixation, blinking, and eventual dilation of the pupils</li> </ul>
Electrodermal activity, galvanic skin response, and skin conductance response Heart rate Pupillometry Biometric	<ul style="list-style-type: none"> <li>• Inferences of emotional commitment (engagement) and arousal during marketing stimuli</li> <li>• Idem on interpersonal relationships with others of different status;</li> </ul>	<ul style="list-style-type: none"> <li>• Well-validated and easy-to-use techniques</li> <li>• Equipment allows more natural interactions with the environment</li> </ul>	<ul style="list-style-type: none"> <li>• Do not allow to determine the valence of the emotion (positive or negative)</li> </ul>	<ul style="list-style-type: none"> <li>• Responding to communication stimuli</li> <li>• Sympathetic nervous system that changes the sweat levels in eccrine glands of the palms or feet</li> </ul>
Facial electromyography and facial expressions Biometric	<ul style="list-style-type: none"> <li>• Information on the emotional valence of information processing during decision-making and processes such as negotiations</li> <li>• Valence of response to marketing stimuli, especially advertisements and packaging</li> </ul>	<ul style="list-style-type: none"> <li>• Dynamic tracking of emotional responses to ongoing stimuli</li> <li>• Non-invasive techniques with good temporal resolution</li> <li>• Available facial coding software algorithms</li> </ul>	<ul style="list-style-type: none"> <li>• Require attaching electrodes directly to the face (laboratory environment)</li> </ul>	<ul style="list-style-type: none"> <li>• Muscle activity through electrical impulses caused by muscle fibres during the contraction of the two main facial muscles (the corrugator and the zygomaticus)</li> </ul>

Source: Own elaboration on basis of Karmarkar and Plassmann (2019) and Oliveira et al. (2022).



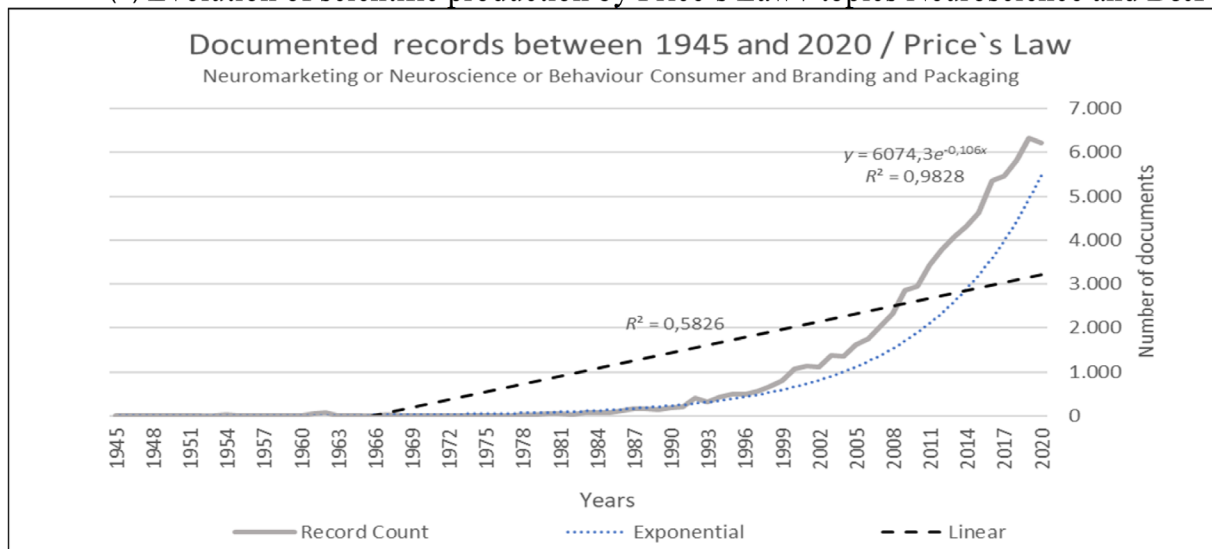
**FIGURE 2** Bibliometric analysis process. Source: Own elaboration.

Access: All Open Access’, ‘Document Types: Articles’. In this search, process 12,283 records were found. Interestingly, a noticeable decrease was detected in contribution of the ‘Business Economics’ area. In the preliminary search, it was positioned as the second in the ranking with a contribution of 19%, but it dropped to the 35th position with a contribution of 2.8%. In this sense, Plasmann et al. (2015) expressed their concerns that fewer articles related to the consumer neuroscience disciplines, such as economics or finance, have appeared, and even wondered whether this means that the contributions moved towards neuroscience, but not to market research. Also, Spence et al. (2019) reported a limited number of published academic research studies in this area, mostly theoretical in nature, that is, simply detailing some of the brain networks involved (Kühn et al., 2016)

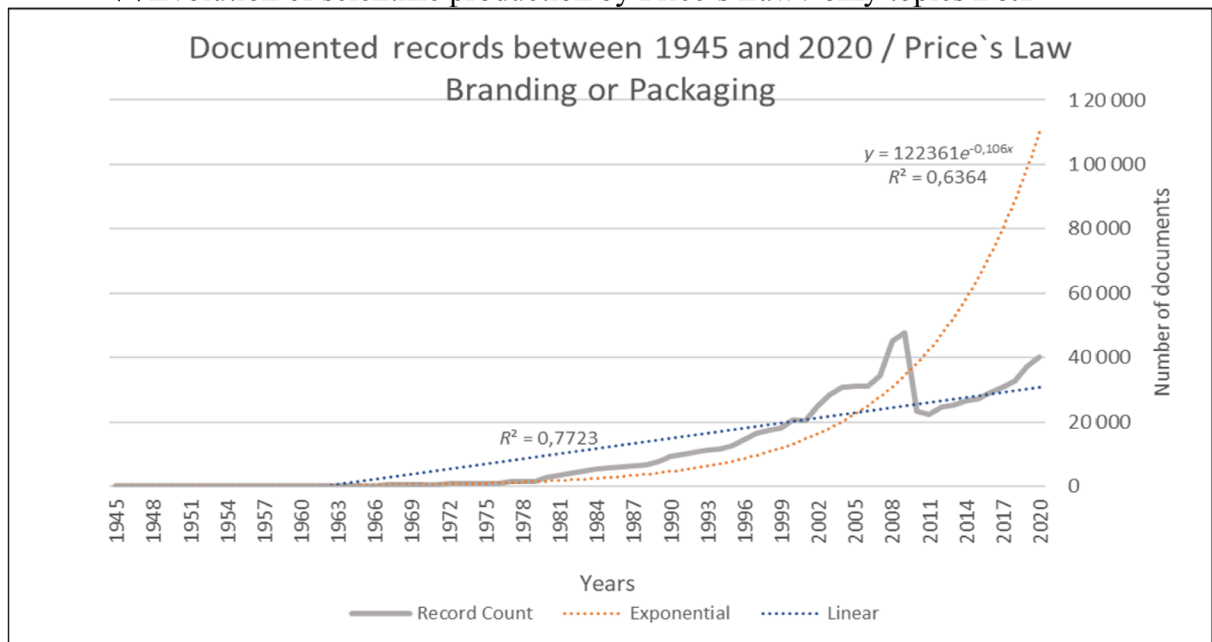
and most of the time focused on academic research rather than on market research (Spence et al., 2019).

In this sense, the authors agreed to concentrate further analysis in a research area of ‘Business Economics’, which is the field closest to business. Therefore, under the ‘Business Economics’ area, 343 records were identified. These results were later refined by reviewing titles and abstracts, eliminating the irrelevant ones (the topic of interest is peripheral to the publication) and incomplete ones (lack of some data necessary for relational treatment, as a research area, country, and author). Ultimately, a sample of 258 records was obtained. Thus, for the detection of authors’ productivity, the Inverse Lotka Model was used, which facilitates obtaining the ‘elite’ and ‘transitory’ authors of a subject (Da Silva et al., 2019). Figure 4

## (a) Evolution of scientific production by Price's Law / topics Neuroscience and B&amp;P



## (b) Evolution of scientific production by Price's Law / only topics B&amp;P



**FIGURE 3** (a) Evolution of scientific production by Price's Law/topics Neuroscience and B&P. (b) Evolution of scientific production by Price's Law/only topics B&P. Source: Own elaboration.

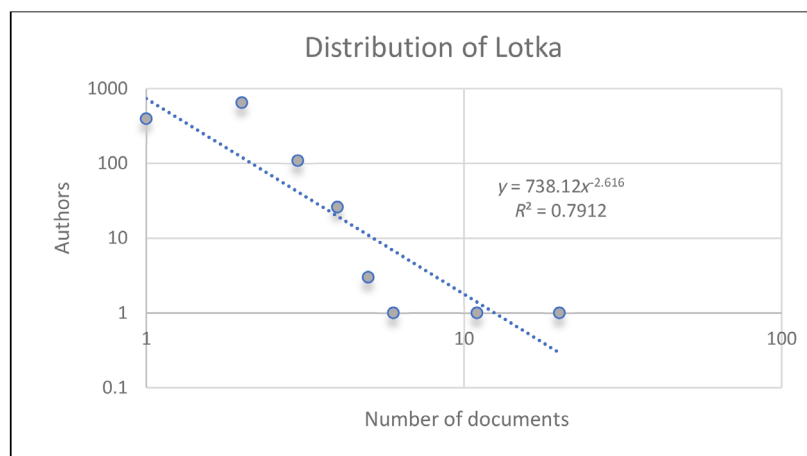
reflects distribution on a logarithmic scale, whose coefficient of determination  $R^2 = 29.6\%$  is weak for the purpose of interpreting an adequate fit to the predicted model. However, Figure 3 presents a reasonable approximation to the assumptions of the law and there are many authors with few articles that could be defined as 'transitory' authors, compared with few 'elite' authors with many articles.

Subsequently, a bibliometric data mining was performed analysing the citation, co-citation, and co-occurrence networks of keywords generated with VOSviewer V1.6.17, a programme that facilitates the visualization of maps based on nodal distance (Van Eck & Waltman, 2020). The objective of this software is to create maps

based on a network data, whether from scientific publications or journals, researchers, countries, keywords, or terms. Elements of these networks can be connected through co-authorship, co-citation, bibliographic coupling, or co-occurrence links. There may be a link or bond between any pair of elements, which is a connection of two elements. Elements can be grouped into clusters (a set of elements included in a map). Clusters in the VOSviewer do not overlap and it is not necessary to exhaustively to cover all the elements of a map (Van Eck & Waltman, 2020).

Consequently, a complete synthesis of research is required to clarify the current state of the scientific evidence, as it presents an





**FIGURE 4** Distribution of the number of authors according to their productivity by Inverse Lotka Model. Source: Own elaboration.

increasing number of findings. For this reason, an empirical and content review was carried out based on 53 studies covering the years 1999–2021. The selection of these articles was based on their relevance and focuses on the field of branding and packaging. The results obtained are presented through a novel classification approach based on key mental processes in branding and packaging research, such as attention and memory, emotions and motivation, reward, and decision-making systems (Plasman et al., 2015; Solnais et al., 2013; Stasi et al., 2018). Given the cross-cutting nature of these processes, work on inter-individual differences and prediction analysis will be added to them. The objective is to be able to classify order and finally discuss the main findings reported in this research field, thus facilitating a comparative analysis and a possible future research agenda. Following the structure proposed by Bilro and Loureiro (2020), the authors use a simple TCM framework by reviewing Theoretical cognitive processes in branding and packaging (attention and memory, emotions, motivation, reward, and decision-making systems), the Characteristics of the findings, and the Methodology (measurements) used, to highlight knowledge gaps and suggest new directions for the future research agenda.

## 4 | RESULTS

Price's Law states that the development of the scientific field goes through four stages: precursor, exponential growth, consolidation, and finally decline in scientific production (Price, 1963). The results of the descriptive analysis show that the field of study is in a phase of an exponential growth (Figure 3a) with a high rate of international collaboration and a high fragmentation of the literature, consistent with its multidisciplinary origin. To detect the productivity of the authors, the inverse Lotka Model was used, which facilitates obtaining the 'elite' and 'transient' authors of a topic (Da Silva et al., 2019). Despite a weak determination coefficient ( $R^2 = 29.6\%$ ), the graph in Figure 4 reflects a reasonable approximation to the assumptions of the law, where few 'elite' authors concentrate many articles and suggesting a stage of strong development of the research field.

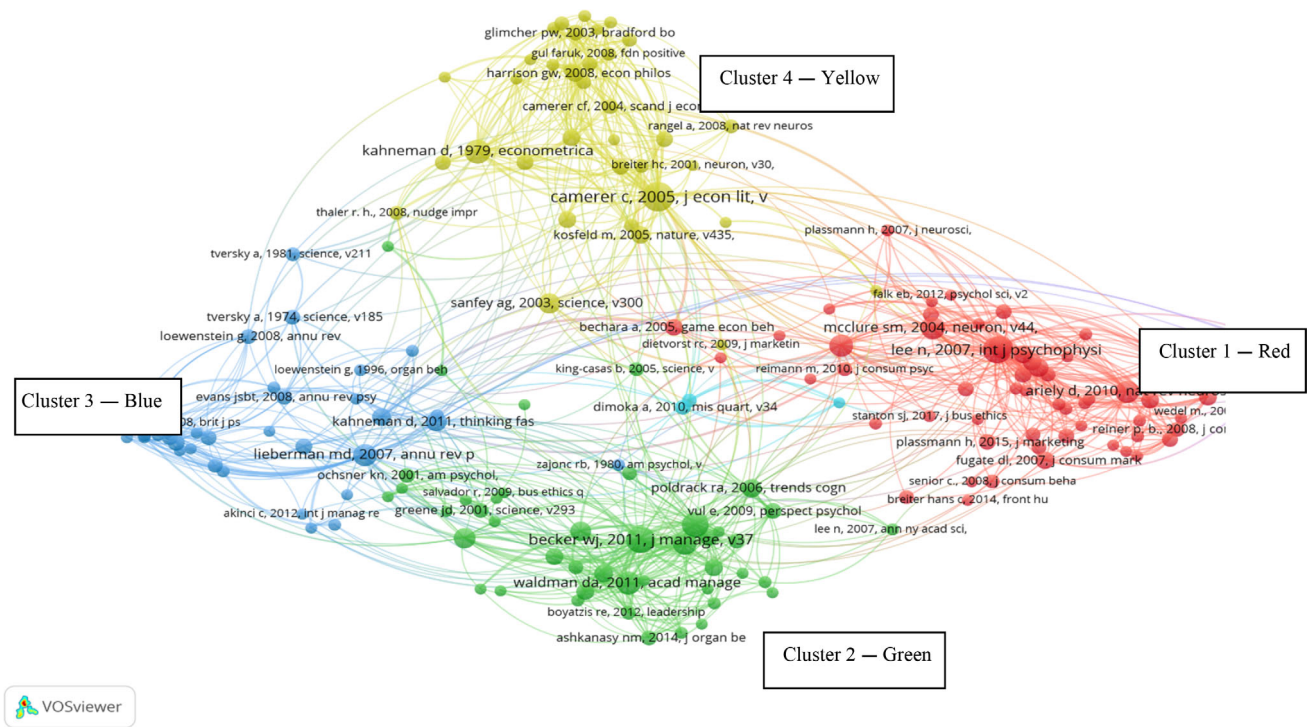
### 4.1 | Co-citation analysis by the authors

A nodal network analysis presents four large co-citation clusters of authors: first cluster led by Lee, N., Plassman, H., McClure, S., and Kenning, M.; second cluster led by Lindebaum, D., Becker, W. J., Senior, C., and Waldman, D. A.; third cluster led by Hodgkinson G. P., Lieberman, M. D., Healey, M. P., and Tversky, A., and fourth cluster led by Camerer, C. F., Kahneman D., Glimcher, P., and Sanfey, A. G. (Figure 5 and Table 2).

### 4.2 | Co-occurrence analysis

Showing a multidisciplinary character, the data show five major topics of interest which have tentatively been labelled as follows: 'Neuromarketing', 'Neuromanagement', 'Cognitive Neuroscience', 'Decision-making/reward system—Consumer Neuroscience', and 'Neuroeconomics' (Figure 6 and Table 3).

- Cluster no. 1, called 'Neuromarketing', together with neuroscience concepts, such as Behaviour, Neuromarketing, Consumer Behaviour, organizes classic marketing concepts (Brand, Advertising, and Packaging). This cluster highlights the use of 'eye tracking' (ET) and it monopolizes 286 occurrences.
- Cluster no. 2, entitled 'Neuromanagement' includes 'Leadership, Management and Performance' together with 'Neuroscience' as the main keywords. It presents 181 occurrences.
- Cluster no. 3, named as 'Cognitive Neuroscience'. The main terms are 'Brain, Emotion, Organizational Neuroscience and Cognitive Neuroscience'. It concentrates 159 occurrences.
- Cluster no. 4, titled 'Decision-making/Reward System/Consumer Neuroscience' by incorporating terms such as 'decision-making, functional magnetic resonance imaging (fMRI), Consumer Neuroscience, prefrontal cortex, and OFC'. The use of fMRI stands out. It represents 126 occurrences.
- Cluster no. 5, known as 'Neuroeconomics' with terms such as 'Neuroeconomics, Model, Economics or Psychology' includes 67 occurrences.



**FIGURE 5** Co-citation analysis by the authors. Source: Own elaboration.

These clusters can be understood as the driving themes, those of greatest attraction for researchers in the field of branding and packaging from a perspective of consumer neuroscience in the 'Business Economics' research area.

Ultimately, the nodal network analysis revealed a group of relevant authors and the interconnections between them, which could represent schools and/or ways of thinking and five major thematic fields (neuroscience branches) from which branding and packaging research is approached.

In relation to the content review based on 53 article studies covering the years 1999–2021, the results have been classified based on the key mental processes in branding and packaging research, such as attention and memory, emotions and motivation, and reward and decision-making systems (Plasmann et al., 2015; Solnais et al., 2013; Stasi et al., 2018). Given the cross-cutting nature of these processes, work on inter-individual differences and prediction analysis is added to them. Table 4 presents the most important results highlighted in this article, chronologically ordered and according to the cognitive constructs detailing the applied research techniques and the sample size, whenever possible.

#### 4.2.1 | Attention and memory

Empirical findings confirm that there is a gaze bias, that is, we look at what interests us most (Pieters & Warlop, 1999), which results in a certain correlation between attention to a brand or product (e.g., time and number of fixations in area of interest (AOI) and their final choice by

the subject (Graham & Jefery, 2012). Thus, visual attributes, such as the colour and shape of the container (Itti & Koch, 2001) or brightness (Milosavljevic, Koch, & Rangel, 2011; Milosavljevic, Navalpakkam, et al., 2011), can alter the visual behaviour of consumers. Additionally, the presence of visual elements (pictorial and textual) favour brand memorization (García-Madariaga et al., 2018; Wedel & Pieters, 2008), especially in less familiar brands for the subject (Underwood et al., 2001). In fact, in a study conducted by Piqueras-Fizman et al. (2013), it was found that the images on the package labelling and the shape of the container influenced consumers' willingness to buy it. But also, they can divert the subject's attention from the central elements that they want to highlight (Retamosa Ferreiro et al., 2021). Similarly, Gawasane et al. (2011) pointed out the importance of branding, showing that it receives more attention than any other aspect of packaging. Similarly, Rebollar et al. (2015) identified two different basic patterns of packaging visualization, one based on the importance of the elements and the second a tendency to visualize from left to right related to the western reading system. Thus, studies on design preferences in wine labelling, analysing the areas where the consumer pays more attention, Retamosa Ferreiro et al. (2021) reported that due to the Z pattern of human reading, the way in which a consumer observes the label is done from top to bottom and that in general, the elements that attract the most attention are those, which are in the central vertical line. Moreover, they discovered that those labels with conceptual or abstract drawings require greater consumer attention to decipher them and may affect the attention devoted by the subject to other elements.

Knowledge influence and degree of engagement with a brand is presented in brand-related studies. Chandon et al. (2002) described

TABLE 2 Co-citation clusters.

No	Co-citation Author	Cluster 1—red			
		Year	Citations	Total (%)	Cum. (%)
1	Lee, N.	2007	57	11.4	11.4
2	Plassman, H.	2008	51	10.2	21.6
3	Mcclure, S. M.	2004	36	7.2	28.9
4	Kenning, P.	2007	21	4.2	33.1
5	Ariely, D.	2010	19	3.8	36.9
6	Knutson, B.	2007	18	3.6	43.3
7	Yoon, C.	2006	18	3.6	46.9
8	Fugate D. L.	2008	17	3.4	50.3
9	Venkatraman, V.	2012	17	3.4	53.7
10	Hubert, M.	2008	12	2.4	56.1
11	Reimann, M.	2010	12	2.4	58.5
12	Morin, C.	2011	11	2.2	60.7
13	Wilson, R. M.	2008	10	2.0	62.7
No.	Co-citation Author	Cluster 2—green			
		Year	Citations	Total (%)	Cum. (%)
1	Lindebaum, D.	2013	42	11.8	11.8
2	Becker, W. J.	2011	38	10.6	22.4
3	Senior, C.	2011	30	8.4	30.8
4	Waldman, D. A.	2011	30	8.4	39.2
5	Dimoka, A.	2010	20	5.6	44.8
6	Poldrack, R. A.	2006	20	5.6	50.4
7	Greene, J.	2002	18	5.0	55.5
8	Ashkanasy, N. M.	2014	13	3.6	59.1
9	Bagozzi, R. P.	2013	12	3.4	62.5
10	Balthazard, P. A.	2012	11	3.1	65.5
11	Butler, M. J. R.	2007	11	3.1	68.6
12	Hannah, S. T.	2013	10	2.8	71.4
No.	Co-citation Author	Cluster 3—blue			
		Year	Citations	Total (%)	Cum. (%)
1	Hodgkinson G. P.	2008	44	16.5	16.5
2	Lieberman, M. D.	2007	27	10.2	26.7
3	Healey, M. P.	2014	15	5.6	32.3
4	Tversky, A.	1974	15	5.6	38.0
5	Lowenstein, G.	2008	14	5.3	43.2
6	Evans, JSBT	2008	13	4.9	48.1
7	Damasio, A. R.	1994	12	4.5	52.6
8	Barsade, S. G.	2002	10	3.8	56.4
9	Powell, T. C.	2011	9	3.4	59.8
10	Dane, E.	2007	8	3.0	62.8
No.	Co-citation Author	Cluster 4—yellow			
		Year	Citations	Total (%)	Cum. (%)
1	Camerer, C. F.	2005	55	16.7	16.7
2	Kahneman D.	1979	40	12.1	28.8
3	Glimcher, P.	2011	38	11.5	40.3



TABLE 3 Co-occurrence clusters.

No.	Cluster no. 1—red Keyword	Neuromarketing		
		No. occurrences	Total (%)	Cum. (%)
1	Behaviour	34	12	12
2	Neuromarketing	32	11	23
3	Choice	19	7	30
4	Eye tracking/eye-tracking	19	7	36
5	Consumer behaviour/consumer behaviour	17	6	42
6	Brand/brands	16	6	48
7	Consumer/consumers	15	5	53
8	Memory	15	5	58
9	Attention	14	5	63
10	Advertising/advertising effectiveness	11	4	67
	...			
23	Packaging	5	2	100
		286	100	
No.	Cluster no. 2—blue Keyword	Neuromanagement		
		No. occurrences	Total (%)	Cum. (%)
1	Neuroscience	75	41	41
2	Leadership	17	9	51
3	Management	12	7	57
4	Performance	12	7	64
5	Science	9	5	69
6	Neuroethics	8	4	73
7	Personality	8	4	78
8	Ethics	7	4	82
9	Innovation	6	3	85
10	Organizations	6	3	88
11	Work	6	3	92
12	Challenges	5	3	94
13	Organizational cognitive neuroscience	5	3	97
14	Strategy	5	3	100
		181	100	
No.	Cluster no. 3—green Keyword	Cognitive neuroscience		
		No. occurrences	Total (%)	Cum. (%)
1	Brain	34	21	21
2	Emotion	16	10	31
3	Organizational neuroscience	14	3	40
4	Cognitive neuroscience	13	8	48
5	Information	13	8	57
6	Neural basis	11	7	64
7	Social cognitive neuroscience	10	6	70
	...			
15	Technology	5	3	100
		159	100	
No.	Cluster no. 4—yellow Keyword	Consumer neuroscience		
		No. occurrences	Total (%)	Cum (%)
1	Decision-making	36	29	29
2	fMRI	20	16	44



TABLE 3 (Continued)

No.	Cluster no. 4—yellow Keyword	Consumer neuroscience		
		No. occurrences	Total (%)	Cum (%)
3	Consumer neuroscience	11	9	53
4	Reward	11	9	62
5	Prefrontal cortex	10	8	70
6	Self-control	10	8	78
7	Orbitofrontal cortex	7	6	83
	...			
11	Uncertainty	5	4	100
		126	100	
No.	Cluster no. 5—purple Keyword	Neuroeconomics		
		No. occurrences	Total (%)	Cum (%)
1	Neuroeconomics	24	36	36
2	Model	16	24	60
3	Economics	13	19	79
4	Psychology	9	13	93
5	Emotions	5	7	100
		67	100	

Source: Own elaboration.

(Schaefer & Rotte, 2007), neural correlates of brand perception (Cheung et al., 2010), preference (Santos et al., 2011), and brand recall (Esch et al., 2012). Studies done by Madzharov and Block (2010); Orth and Malkewitz (2008), and Reimann et al. (2010) support that packaging design influences consumers' impressions on brand, brand inferences, and brand choices. Thus, a unique packaging design offers a positive value of an object to consumers and encourages the choice of a higher-priced brand with attractive packaging, rather than a well-known brand with less aesthetic and more standardized packaging (Hwang & Kim, 2021). However, Orth et al. (2019) recently illustrated that changes in packaging design also can harm consumer perception of brand legacy and purchase intent due to confusion arising from design discontinuity.

Some studies focus on how products are labelled, rather than on how products are packaged. Ng et al. (2011) report that in obese individuals several brain regions become more activated when a food product is perceived to have a higher calorie content. They found that obese participants showed levels of activation in somatosensory taste and reward evaluation regions when the product was presented as a regular shake versus an identical shake labelled as low calorie. On the other hand, Ares et al. (2013) found that the most observed areas to judge authenticity were brand, list of ingredients and nutritional information, but for the willingness to purchase the order was ingredients, nutritional information and brand. But Koenigstorfer et al. (2014) concluded that the way in which nutritional information is presented can affect both visual attention and healthy decision-making. Jones and Richardson (2007) observed that a traffic light on the label was more effective in communicating healthiness than a standard label. Van Herpen and Van Trijp (2011) also confirmed that traffic light labels

and logos are very effective in promoting healthy decisions (nutritional labelling). However, Antunez et al. (2013) concluded that the traffic light system focused the subjects' attention but failed correctly to communicate the amount of salt in the bread. In another study with Eye Tracker, the perception of the healthiness of the product (in yogurt) was based on the nutritional label, while the purchase intention was supported by the brand and the nutritional label (Orquin & Scholderer, 2011). Vidal et al. (2013) also confirmed that the only attribute that affected perceived healthiness was fat content (in yogurt). In a more recent study, Medina-Molina et al. (2021) found gender differences in visual impact of the (front-of-pack) linked to heuristics, establishing that women respond more moderately to negative evaluations.

#### 4.2.2 | Emotions and motivations

There is empirical evidence that highlights emotional factor in relation to the subjective evaluation of brands. Thus, neural activity differs due to exposure to high-end brands (vs. low end) that are associated with higher emotional value (Pozharliev et al., 2019). Certain biometric correlates confirm that skin conductance was reduced when consumers saw the brand they liked best compared with the brand they disliked (Walla et al., 2011). Likewise, the brand effect causes children to be more excited when presented with their favourite branded product compared with the same product, but without a brand (Smith et al., 2019). Also, Langner et al. (2015) confirmed that beloved brands can be just as exciting as close friends and elicit a more positive valence than interpersonal relationships. However, the evidence is not

TABLE 4 Psychophysiological findings and measures used in the B&amp;P studies.

Findings of interest	Measurement	Sample size	Author
Attention and memory			
Staring bias was confirmed, and consumers were more likely to choose those brands which they were most focused on	ET	54	Pieters and Warlop (1999)
The surface of the brand element attracted more attention compared with pictorial and text elements	ET	88	Wedel and Pieters (2008)
Package images increased brand awareness, but only for nonfamiliar ones	ET	128	Underwood et al. (2001)
Visual attributes such as brightness, colour, or shape can alter consumers' visual behaviour while looking at a shelf	ET	NDA	Itti and Koch (2001)
Brand recall was driven more by brand familiarity than by attention paid at the moment of the task	ET	159	Chandon et al. (2002)
Examining of two types of nutrition labels, a traffic light on the label was more effective at communicating healthiness than a standard label	ET	NDA	Jones and Richardson (2007)
Visual attention of consumer was driven by the number of on-shelf facings	ET	344	Chandon et al. (2002)
Packaging brightness can influence purchase decisions	ET	NDA	Milosavljevic, Koch, and Rangel (2011) and Milosavljevic, Navalpakkam, et al. (2011)
The perception of the healthiness of the product (yogurt) was based on the nutritional label, while the purchase intention was supported by the brand and the nutritional label	ET	NDA	Orquin and Scholderer (2011)
Traffic light labels and logos are very effective in encouraging healthy choices (nutrition labelling)	ET	NDA	Van Herpen and Van Trijp (2011)
The Brand receives more attention than any other aspect of packaging design	ET	17	Gawasane et al. (2011)
Participants looked longer at the labels of the products they finally decided to buy	ET	203	Graham and Jefery (2012)
Familiar brands activate the hippocampus, which can be interpreted as memory usage for consumers to recall their experience with the brand	fMRI	25	Santos et al. (2011)
Consumers preferred and spent more time looking at national brands than private brands	ET	139	Hurley et al. (2013)
The most observed areas for willingness to purchase, the order was ingredients, nutritional information, and brand	ET	53	Ares et al. (2013)
The images on the packaging label and the shape of the jar (jam) influenced consumers' willingness to buy it	ET	NDA	Piqueras-Fiszman et al. (2013)
The only attribute that affected perceived healthiness was the fat content	ET	NDA	Vidal et al. (2013)
Concluded that the traffic light system focused the attention of the subjects but failed to correctly communicate (salt in the bread)	ET	NDA	Antunez et al. (2013)
The way nutrition information is presented can affect both, visual attention, and healthy decision-making	ET	NDA	Koenigstorfer et al. (2014)
People who rely more on rational thinking make more search and analysis of nutritional information for their choices	ET	NDA	Ares et al. (2013)
The study identified two different basic display patterns on packaging: an exploration based on the importance of design elements, and a tendency to start viewing from left to right related to the Western reading system	ET	127	Rebollar et al. (2015)
The presence of visual elements in the packaging, images, or texts, increased participants attention. Colour modifications do not have significant effect on attention	EEG, ET	40	García-Madariaga et al. (2018)
Visual attention captured with ET is different for weak and strong brands	ET	178	Oliveira and Giraldi (2019)
No significant differences were found in EEG, GSR, and asserting metrics on food packaging. There were discovered correlations between the appreciation and the purchase intention	EEG, GSR, ET	43	Moya et al. (2020)
	ET	58	Retamosa Ferreiro et al. (2021)

TABLE 4 (Continued)

Findings of interest	Measurement	Sample size	Author
The way in which consumer looks at the label is done from the top down. The elements that attract the most attention are those located in the central vertical line			
<b>Emotions</b>			
Skin conductance was reduced when saw the brands that liked, assuming that brands that like may trigger feelings of relaxation	EDA, EMG, HR	21	Walla et al. (2011)
Increased emotional arousal for a recently formed relationship with a brand, but not for already established relationships	EDA	17	Reimann et al. (2012)
There are no statistically significant differences between psychophysiological responses to the most loved versus least loved brands	EDA, HR, EMG	56	Maxian et al. (2013)
There was no interaction between emotional arousal elicited by featured brands or additional recall of those brands	EDA	60	Gangadharbatla et al. (2013)
Loved brands can be just as exciting as close friends and elicit a more positive valence than interpersonal relationships	EDA	60	Langner et al. (2015)
Correlations were found between neurophysiological measures, the effectiveness of an ad (remembering, liking) and the number of visits to the ad on YouTube	ET, EEG, fMRI	35	Guixeres et al. (2017)
Neural activity differs due to exposure to luxury brands (vs. basic) which are associated with higher emotional value	EEG	40	Pozharliev et al. (2019)
Children are more excited when they are presented with their favourite branded products compared with the same products, but without a brand	EDA	48	Smith et al. (2019)
<b>Approach/avoidance motivation</b>			
Frontal asymmetry predicts approach/avoidance tendencies towards the brand and product	EEG	45	Ohme et al. (2010)
Stimuli perceived as the most pleasant were associated with an asymmetric increase in neural activity in the left hemisphere, whereas unpleasant advertisements were associated with a relatively greater increase in activity in the right hemisphere	EEG	NDA	Vecchiato et al. (2014)
Brain activity (especially in the frontal, temporal, and occipital regions) affects an indication of preference for a product	EEG	18	Khushaba et al. (2013)
Frontal asymmetry corrects differences in approach/avoidance behaviour towards national and private brands and can lead to product choice	EEG, ET, EMG, EDA	21	Garczarek-Bąk and Disterheft (2018)
<b>Reward system</b>			
Activity in the VMPFC correlated with taste preferences due to the VMPFC's assessment of reward value as part of its role in the decision-making process	fMRI	NDA	McClure et al. (2004)
Attractive packages stimulate changes in cortical activity in areas related to visual attention and memory, as well as regions associated with reward. Unattractive ones are accompanied by activity in areas associated with perceived response conflict and expected risk	fMRI	11	Stoll et al. (2008)
Brand processing is associated with a front-central reward-related network activity	EEG	26	Lucchiari and Pravettoni (2012)
The VMPFC is activated when an individual is rewarded. The reward was considered when participants saw a product that possessed aesthetic properties	fMRI	NDA	Plasmann et al. (2012)
Use of multivariate patterns to predict consumer response	fMRI	22	Van der Laan et al. (2012)
Attractive packages activated regions associated with reward, whereas unattractive packages activated regions associated with negative emotions	fMRI	22	Hubert et al. (2013)
<b>Decision-making</b>			
The VMPFC was activated during the choice of brand between two similar products	fMRI	NDA	Deppe et al. (2005)

(Continues)

TABLE 4 (Continued)

Findings of interest	Measurement	Sample size	Author
A greater activation of the orbitofrontal cortex when the same wine was presented with a higher price compared with the original	fMRI	20	Plasmann et al. (2012)
There were observed significant increases in activation of the ventromedial prefrontal cortex (VMPFC), the striatum, and in the cingulate cortex with the presentation of attractive packaging	fMRI	17	Reimann et al. (2010)
It was found that labelling a food as organic led to greater activity in the ventral striatum	fMRI	NDA	Linder et al. (2010)
Obese participants were found to show activation levels in reward evaluation regions when the product was presented as a regular shake versus an identical shake labelled 'low calorie'	fMRI	34	Ng et al. (2011)
Activation of the VMPFC increased before the express choice of the subject in the case of new versus familiar brands	fMRI	NDA	Reimann et al. (2012)
The VMPFC and the ventral striatum, consistently exhibit increased activity for more valuable items across a wide range of decision paradigms, reward modalities, and processing stages	fMRI	NDA	Bartra et al. (2013)
Differences were found between the observation of the public labels and private labels. Higher prices (both in public and private labels) generated more purchasing decisions	fMRI	25	Santos et al. (2016)
The sales prediction value derived from fMRI based on visual communication of the product was correlated with consumers who purchased the product	fMRI	18	Kühn et al. (2016)
Differences in impulsive buying tendencies affect the modulation of brain activity when faced with attractive, unattractive, and neutral packaging images	fMRI	22	Hubert et al. (2018)

Abbreviations: EDA, electrodermal activity; EEG, electroencephalogram; EMG, electromyogram; ET, eye tracking; fMRI, functional magnetic resonance imaging; GSR, galvanic skin response; HR, heart rate.

Source: Own elaboration.

linear in all cases. Reimann et al. (2011) observed that the emotional arousal increased in newly formed close relationships with a brand, but not in established ones. Furthermore, remarkable biometric correlates in brain activity (especially in the frontal, temporal, and occipital regions) have been found to suggest a preference for a product (Khushaba et al., 2013; Ohme et al., 2010). Stimuli perceived as more pleasant were associated with an asymmetric increase in neuronal activity in the left hemisphere, whereas less pleasant ones were associated with a relatively greater increase in activity in the right hemisphere (Vecchiato et al., 2014). Thus, frontal asymmetry corrects differences in approach/avoidance behaviour towards public and private labels and can lead to product choice (Garczarek-Bąk & Disterheft, 2018).

#### 4.2.3 | Reward and decision-making systems

Findings show that neuroimaging techniques create a more cross-sectional scope to various cognitive processes, as they add relevant information from the deepest parts of the brain. Neuroscience research plays an important role in developing consumer decision-making theories (Ariely & Berns, 2010). Thus, empirical evidence indicates that brand processing is associated with front-central reward-related network activity. Deppe et al. (2005) observed that the

subject's favourite brand activated the (VMPFC) significantly more than other less-appreciated brands. The same product can elicit distinct frontal region activity when the brand label is changed (Lucchiari & Pravettoni, 2012). Scientific literature repeatedly shows that this area is activated when an individual is rewarded (McClure et al., 2004; Plasmann et al., 2012). The research presented by McClure et al. (2004) showed the movement in the (VMPFC) during a blind test of coke, where taste preferences correlated to reward value assessment. Plasmann et al. (2012) confirmed the activation of the VMPFC when an individual was rewarded. Their study revealed that the reward was considered to occur, when the participant saw a product that had aesthetic properties. In this context, attractive containers induce changes in cortical activity in areas related to visual attention and memory, as well as in regions associated with the reward. Unattractive packages stimulated activity in areas associated with perceived response conflict, disgust, and expected risk (Hubert et al., 2013; Stoll et al., 2008). Several studies conducted by Reimann et al. (2010) investigated the effect that aesthetic properties had on brain activity. The studies revealed that participants were selecting products with a better image more than products with a standard packaging, even when it was from a well-known brand. Significant increases in activation in the (VMPFC), striatum (especially the right NAcc), and cingulate cortex were observed with the presentation of attractive versus unattractive packaging (Reimann et al., 2010). It was

also reported that for participants it took longer to decide with the product that had better aesthetic packaging. Similarly, the activation of the VMPFC increased, when the subject expressed preference a new versus familiar brand and when the brand's logo was presented individually (Reimann et al., 2012). Bartra et al. (2013) confirmed that the VMPFC and the ventral striatum consistently exhibit higher activity for more valuable items. Furthermore, this pattern occurred reliably across a wide range of decision paradigms, reward modalities, and processing stages. Thus, rewards were consistently associated with the striatum, and the 'subjective value' was consistently associated with activity in the prefrontal (and orbitofrontal) cortex.

#### 4.2.4 | Inter-individual differences

Many findings highlight the important role of the mesolimbic system, specifically the striatum/NAcc and VMPFC in encoding different facets of an individual's perceived value. Hubert et al. (2013) investigated with fMRI, whether inter-individual differences in impulse consumers' buying tendencies affect the perception of packaging that differs in attractiveness. The results showed that the perception of product packaging is moderated by individual differences in impulse buying tendencies even at the neuropsychological level. Successively, it was confirmed that there is a relationship between impulse buying tendencies and increased activity in the so-called impulsive system (caudate, putamen, and thalamus) and decreased activity in the reflexive system (VMPFC and DLPFC); (Hubert et al., 2018). On the other hand, Ares et al. (2013) assumed that people who rely more on rational thinking perform a greater search and analysis of nutritional information for their final choice. More recently, Hwang and Kim (2021) claimed that the level of visual processing, as an individual trait, can moderate the impact of packaging design. Thus, they stated that the results identify affective hedonism (affective response) and perceived quality (cognitive response), as mediating mechanisms underlying the impact of design on brand value.

#### 4.2.5 | Prediction

There are studies that analyse the incidence of predictive capacity. Van der Laan et al. (2012) used multivariate patterns (MVPA) to predict consumer response. The data obtained from their research provided predictive rates (around 60%) derived from brain activity in medial parts of the right superior frontal gyrus and left middle occipital gyrus. However, in a study on food packaging Moya et al. (2020) did not find any significant differences in the electroencephalography (EEG), galvanic skin response, and asserting metrics. Correlations were discovered between the appreciation and the purchase intention, and between the time in AOI and the number of fixations in AOI. More promising results on the predictive capacity of neuroscience tools for studying consumers can be found in the research carried out by Guixeres et al. (2017). Using ET, EEG, and fMRI, they found correlations between neurophysiological measures, the effectiveness of an ad

(remembering, liking), and the number of views of the ad on YouTube. In a study that indicates possible future studies, Kühn et al. (2016) found that a composite measure of neuronal activation taken from several points in the brain (Nacc, medial OFC, DLPFC, insula, amygdala, hippocampus, inferior frontal gyrus, and dorsomedial prefrontal cortex) could be used to predict (correlate) actual store sales data. Thus, the fMRI-derived sales prediction value based on product communication display was correlated with consumers who purchased the product, and relative sales data were better predicted by the blood oxygen level dependent (BOLD) signal than by self-reports. More recently, Garczarek-Bąk et al. (2021) incorporated several psychophysiological methods aimed at evaluating predictive values in purchase decisions. The results obtained proved their advantage over self-reports. In this context, the electrodermal activity (EDA) measures of purchase decision are confirmed based on brand familiarity, as EDA was linked to being more likely to purchase familiar brands (with similar packaging).

## 5 | DISCUSSION AND FUTURE RESEARCH AGENDA

At the beginning of the 21st century, the field of consumer neuroscience has made a significant progress in generating knowledge related to marketing and consumer behaviour. Since 1981, when Sidney Weinstein evaluated the electrophysiological response to product packaging using event-related potential (ERP) the new discipline of consumer neuroscience gained credibility and confidence in marketing activities, such as branding, packaging, and others (Stasi et al., 2018; Torreblanca et al., 2012). Specifically, branding, packaging design, and labelling are in a focus of interest in many neuromarketing studies because the results obtained can be applied for product and service marketing (Walla et al., 2013). The information included in product packaging primary affects the automatic and intuitive part of the brain. Thus, after this first impression, it rationalizes decisions in the logical and reflective part of the brain (Robledo, 2015). The look and feel function of a product has a great impact on the consumer's experience. For all these reasons, the findings obtained through neuromarketing tests can provide information on the emotional effects of design choices (Thomas et al., 2017).

This section discusses the findings highlighted in the previous part by exploring some of the future research agendas derived from them and proposes other research questions that may go beyond the existing literature (Table 5). Regarding the findings described in this article, it should be noted that they have been extracted from studies with different methodologies and designs, which makes their comparison difficult. However, some research shows a special relevance and general insights.

### 5.1 | Attention and memory

The empirical studies confirm that there is a gaze bias, that is, we look at what interests us the most (Pieters & Warlop, 1999), which results



**TABLE 5** Research questions in consumer neuroscience on B&P.

Future research questions	Dimensions	Research questions
Cognitive processes	Attention and memory	What is the gaze pattern in non-Western cultures? How does the gaze bias correlate with the purchase decision? What kind of elements (pictorial, textual) of the packaging improve brand recall? How?
	Emotions and motivations	What emotions does the packaging in hedonic products stimulate? Do the neural correlates match with the functional products?
	Reward and decision-making	How do contextual elements (e.g., purchase for a gift) affect reward perception and decision-making?
	Other involved processes	What are the neural correlates in non-visual (auditory, olfactory, tactile) sensory marketing in B&P? What processes does the evaluation of multisensory packs involve? Which approach to choose, holistic or multidimensional, for the evaluation of packaging? According to what parameters?
Marketing constructs	Brand experience	How does the brand experience influence the evaluation of packaging? Are there different correlates for the evaluation of familiar vs novel brands?
	Positioning	What differential processes stimulate luxury brands in individuals?
	Green, sustainable and healthcare marketing	What mechanisms and processes does nutritional labelling activate? How does green labelling influence visual attention? What are the processes responsible for measuring the valuation bias towards the contextual signals of the labelling (denomination of origin, organic product, etc.)?
Individual differences	Personality traits	How do different individual personality traits (e.g., extraversion/introversion) influence preference and purchase decision?
	Impulse buying trends/rational thinking	What other personality traits (impulse buying tendency, rational thinking) influence preference and purchase decision?
	Sociodemographic data (gender, age, and cultural aspects)	Are there differences in the processes or mechanisms developed in the evaluation of packaging according to sociodemographic variables? Which ones?
Technological progress	E-commerce	The influence of the aesthetics and quality of the packaging in the purchase decision. Is it less in the context of e-commerce? The portability of some tools (Tobii glasses, functional near-infrared spectroscopy) towards more natural contexts. Will it modify the results obtained in a laboratory situation?
	Tool portability	Will the visualization of packaging in the context of virtual or augmented reality trigger brain responses different from those collected in natural environments? In what way?
	Virtual reality, metaverse, artificial intelligence (AI)	How will the AI affect our perception of packaging? How will the B&P be evaluated in the context of the metaverse?
Methodology and prediction	Predictive capacity	How to be able to evaluate and improve the predictive capacity in decision-making of preference and choice of packaging, which is so fundamental for the industry?
	Neuroethics	What additional regulations should/can be adopted to prevent the intrusion into the privacy of the subjects?

Source: Own elaboration.

in a certain correlation between attention to a brand or product (e.g., time and number of fixations in AOI) and the subject's preference or final choice (Graham & Jefery, 2012). Nevertheless, researchers must be cautious, as looking at more does not always mean liking more, so tracking consumers' eye movements cannot be considered a single parameter for predicting packaging preferences (García-Madariaga et al., 2018). In addition, the presence of visual elements (pictorial and textual) favours the memorization of the brand (García-Madariaga et al., 2018; Wedel & Pieters, 2008). This factor of

memorization and recovery of previous experiences with the brand becomes substantial in the empirical evidence. Thus, it is verified that visual attention is different for strong versus weak brands (Oliveira & Giraldo, 2019), and there are processing variations in familiar versus unfamiliar brands (Chandon et al., 2002), because it is understood that familiar brands activate the hippocampus and it can be interpreted as a reminder of the experience with the brand (Santos et al., 2011). Perhaps this phenomenon is also an origin of the differences found in various study areas between 'private labels' and 'public labels'

(Garczarek-Bąk & Disterheft, 2018; Hurley et al., 2013; Santos et al., 2016).

Another aspect for consideration is the packaging display pattern, which according to studies shows a tendency to be viewed from left to right and from top to bottom related to the western reading system (Rebollar et al., 2015; Retamosa Ferreiro et al., 2021). It could be interesting to confirm if this pattern is also found in cultures with different reading systems. Thus, this display phenomenon could be studied not only for packaging, but also for web communication, e-commerce, social networks, and the repercussions that derive from this fact.

Advances in labelling are also noteworthy. Empirical studies show variations in relevant elements depending on whether the aim is to verify authenticity (healthiness) or willingness to purchase (Ares et al., 2013; Orquin & Scholderer, 2011). It is demonstrated that nutritional or health signalling through traffic lights attracts consumers' attention (Jones & Richardson, 2007; Van Herpen & Van Trijp, 2011), although Antunez et al. (2013) concluded that the traffic light system focused the subjects' attention but failed to communicate it correctly (in their case, the amount of salt in the bread). The importance of this research in the field of packaging and labelling for marketing researchers should be highlighted, either to focus the consumer attention on a specific stimulus (brand, slogan) or on relevant textual content (e.g., geographical indication). In relation to packaging, it must be noted that in the marketing environment consumers perceive packaging holistically (García-Madariaga et al., 2018).

## 5.2 | Emotions and motivations

There is also notable empirical evidence that emphasizes the emotional factor in relation to subjective brand evaluation. Neural activity is found to differ due to exposure to luxury brands that are associated with higher emotional value (Pozharliev et al., 2019). Additionally, some biometric correlates confirm that the skin conductance was reduced when consumers saw the brand that they liked more compared with the brand they disliked (Walla et al., 2011). Or by verifying that the stimuli perceived as more pleasant are associated with an asymmetric increase in neuronal activity in the left hemisphere, whereas the less pleasant ones were associated with a relatively greater increase in activity in the right hemisphere (Garczarek-Bąk & Disterheft, 2018; Vecchiato et al., 2014). Hence, it is not surprising that there is an increase in the use of techniques such as EDA, facial expressions, EEG to evaluate, for example, the engagement with a certain brand or a packaging design (Reimann et al., 2012; Smith et al., 2019).

## 5.3 | Reward systems and decision-making

On the other hand, many studies indicate that brand processing is associated with the activity of the network related to the front-central reward. Deppe et al. (2005) found that the subject's favourite brand activated the (VMPFC). The literature repeatedly shows that this area

is activated when an individual is rewarded (McClure et al., 2004; Plasmann et al., 2012). Significant increases in activation in the (VMPFC), striatum (especially in the right NAcc), and cingulate cortex were observed with the presentation of attractive versus unattractive packaging (Reimann et al., 2010). Similarly, attractive packaging induces changes in cortical activity in areas related to visual attention and memory, as well as regions associated with reward. Unattractive packaging is accompanied by activity in areas associated with the perception of response conflict, disgust, and expected risk (Hubert et al., 2013; Stoll et al., 2008). Thus, rewards were consistently associated with the striatum, and 'subjective value' was consistently associated with activity in the prefrontal and OFC (Bartra et al., 2013).

## 5.4 | Inter-individual differences

Some noteworthy research addresses the facet of individual differences. Thus, Hubert et al. (2013) investigated the inter-individual differences in consumer impulsive buying tendencies in relation to the perception of packaging that differs in attractiveness. Ares et al. (2013) concluded that people who rely more on rational thinking engage more in searching and analysing nutritional information for their final choice. More recently, Hwang and Kim (2021) argued that the level of visual processing as an individual trait can moderate the impact of packaging design. Therefore, behavioural and/or neuroscientific future research should address the question of the impact of individual personality traits in relation to purchase preference and decision, investigating different situational influences and hedonic or functional product types (Hubert et al., 2013).

## 5.5 | Prediction

Recently, there have been academic studies interested in evaluating predictive capacity. It has become more common to apply multivariate techniques such as pattern classification to predict decisions (Clithero et al., 2009; Tusche et al., 2010). Also, Van der Laan et al. (2012) used (MVPA) to predict consumer response that provided predictive rates (around 60%). In a more recent study, Kühn et al. (2016) found that a composite measure of neural activation taken from various points in the brain could be used to predict (correlate) actual store sales data, which was better projected by the BOLD signal than by self-reporting. This development in findings helps to move from a more academic to more business-relevant consumer neuroscience (Spence et al., 2019).

Despite the above developments, the consumer neuroscience study field faces important challenges that must be solved, such as sample size and dimension (Jones & Richardson, 2007); accessibility of tools in terms of cost; restrictive legislation for the use of different techniques' and qualification of personnel (Ariely & Berns, 2010; Oullier, 2012); methodology and study rules, especially in non-academic fields (Ramsay, 2015); use of reverse inference in the interpretation of results; development of experiments in unnatural settings (Ariely & Berns, 2010); and in the field that interests us, the recent

development of multisensory packaging that requires an evaluation beyond merely visual parameters (Spence et al., 2019). Hence, authors like Plasmann et al. (2015) and Spence et al. (2019) presented an in-depth study of the challenges and limitations that consumer neuroscience encounters.

## 6 | CONCLUSIONS

This article provides the first exhaustive empirical review and an attempt to classify the contribution of consumer neuroscience and its techniques to the specific study of branding and packaging from the perspective of consumer behaviour research. Previous studies have described some of the characteristics of consumer neuroscience tools (Casado-Aranda & Sanchez-Fernandez, 2022; Harris et al., 2018), developed systematic and bibliometric reviews for the general analysis of the neuromarketing area (Alsharif et al., 2021; Solnais et al., 2013), studied advertising from the field of neuroscience (Lee et al., 2018; Oliveira et al., 2022; Sánchez-Fernández et al., 2021) or more specifically analysed neuromarketing and food choices (Stasi et al., 2018). However, this is the first article, which exclusively pays attention to the research subdomain of branding and packaging from the perspective of consumer neuroscience.

The descriptive analysis results show that the study field is in a phase of an exponential growth with a high rate of international collaboration and highly fragmented literature consistent with its multidisciplinary origin. The nodal network analysis reported a group of relevant authors and interconnections between them, and five major thematic fields from which branding and packaging research is approached from a Business Economics perspective. However, accumulative progress in the field of consumer neuroscience requires a systematic approach to represent the cognitive entities that are recorded, the techniques used to measure mental processes (Poldrack et al., 2011), and the findings derived from them. The semantic infrastructure to characterize the research approach (Neuromarketing, Neuromanagement, Consumer Neuroscience, Cognitive Neuroscience, and Neuroeconomics), the psychological constructs involved and their relationship with brain function require clarification. Sometimes the terminology is ambiguous and other times the cognitive processes are confused with the tasks used to measure them. One problem that arises from this in the literature is that a single task is often associated with multiple constructs (Sabb et al., 2008). This lack of consistency hinders the search process, hampers the generation of meaningful inferences, and limits the increasing value of the knowledge collected in the literature.

In this context, the authors' aim is to develop advances in this research area based on the knowledge of previous studies and findings by highlighting and trying to reconcile contradictory results and detecting research gaps, and consequently intend to give some suggestions on future theories, methods, and experimentation. The application of neuroscience techniques in branding and packaging research is a big step, but to provide brands with relevant answers, it is necessary to continue exploring how different mechanisms and brain

processes influence the evaluation of packaging and consequently the purchase decision. Despite the large number of scholars who are researching on branding and packaging using neuromarketing tools (Stasi et al., 2018), it has been proven that it is a new discipline. Subsequently, its theoretical, empirical, and practical field is developing, and from academia we must provide a valid framework that helps neuromarketing companies by providing metrics capable of responding to what they are supposed to measure. Only through a joint effort, we will be able to achieve standardization in this discipline and eradicate the over-promising and under-delivering that has been affecting the reputation of this field of study (Moya et al., 2020).

In this sense, this work is a starting point for a future research agenda that demonstrates what kind of issues related to branding and packaging could be better addressed by using consumer neuroscience tools. It is important to advance in studying the validity and reliability of neuromarketing so as to eradicate mistrust around the discipline and provide brands with valuable information on the design and evaluation of branding and packaging.

Regarding the limitations of the research, the preliminary bibliometric analysis was based only on the WoS platform. Although it is considered as one of the most prestigious in academia, in the future it would be interesting to expand the study field with other platforms, such as Scopus and/or Google Scholar. Moreover, the analysis of nodal networks using the VosViewer tool depends on the quality of the summaries used as input data. On the other hand, analysis of the nodal networks has been focused on the records under the 'Business Economics' area, so it would be desirable to confirm in future research, whether the resulting thematic areas remain the same. Last, the findings of this article have been extracted from studies with different methodologies and designs, thus the interpretation process can include some bias.

Despite some limitations, there are many opportunities for future research in studying branding and packaging from the consumer neuroscience perspective. In relation to the theoretical corpus, until now their significant advances have been made in understanding reward and decision-making systems. Likewise, there is needed a greater precision in some of the areas involved, such as inter-relationships with linked processes, influence of personal and/or contextual variables, among others. Also, future research may reveal complex mechanisms and processes linked to brand-related constructs, like brand experience, its positioning, the evaluation mechanisms of new brands or the identification of the cognitive and affective processes responsible for mediating the valuation bias towards the contextual signs of packaging such as labelling. This additionally requires reconciling the holistic (García-Madariaga et al., 2018) and multidimensional (Bosshard et al., 2016) approach models for branding and packaging.

Another significant area where research should be developed is into how different individual personality traits (e.g., extraversion/introversion) may influence preferences and purchase decisions. Hence, Leonhardt et al. (2015) investigated, whether a greater processing fluency positively influences the perceived quality of the product, hedonism, and brand value, and how these variables can interact with visual processing and price awareness. Other studies have proposed

the analysis of impulse buying tendencies (Hubert et al., 2013), people who rely more on rational thinking (Ares et al., 2013), or the level of visual processing (Hwang & Kim, 2021). In this sense, future behavioural and/or neuroscientific studies should address the question of the influence of individual personality traits in relation to purchase preference and decision-making and investigate different hedonic or functional situational influences and product types (Hubert et al., 2013).

As regards the methodological approach, there should be advances in generalizing the results obtained, both in terms of methodological design, sample size, and composition, and in terms of the product type analysed. Similarly, it is necessary to be able to extrapolate relevant brand results to other groups, beyond young Western university students. As an example, it is important to remember how the western reading system affected viewing patterns (Rebollar et al., 2015; Retamosa Ferreiro et al., 2021). Regarding products, it could be useful to expand research to more hedonistic or functional products by examining different situational influences (e.g., purchase for own use or purchase as a gift) or studying elements that include sustainability aspects and care for the environment.

Similarly, technological advances have favoured the use of tools in more realistic contexts (Tobii glasses or functional near-infrared spectroscopy application). Therefore, one suggestion should be to explore what the use of virtual or augmented reality technologies can offer in relation to this field of study. The resolution and environmental richness offered by some games with these technologies would be excellent for testing packaging alternatives in realistic situations. In this same way, it would be useful to study how AI can affect branding and packaging communications, and to what extent the development of social networks affects the processes of attention, memory, and engagement with the brand, and how brand loyalty evolves in the metaverse environment. Also, it is necessary to develop multisensory packaging and to study what cognitive processes are involved in their evaluation.

Finally, the predictive capacity of studies should be improved. The combined use of traditional techniques and neurophysiological tools could support a more holistic understanding of consumer behaviour and provide more useful information in defining the best way to design packaging according to consumer claims. In this sense, it is essential to use a multidimensional approach by reasonably applying as many tools as possible to quantify the diverse aspects of brand attitude (Bossard et al., 2016). Therefore, there are many studies that apply multivariate techniques such as pattern classification to predict decisions and models that are based on the underlying neural mechanisms. Likewise, the recent study done by Kühn et al. (2016) is inspiring for the methodological development of future research, in which a composite measure of neuronal activation taken from various points in the brain was used to predict actual store sales data. These developments are helpful in moving from a more academic consumer neuroscience spectrum to more business-relevant findings.

This research intends to be a guide for branding and packaging researchers who are interested in the use of consumer neuroscience techniques and theories. Its objective is to facilitate a greater dissemination of neuroscientific knowledge in the field of marketing and

market research. In the authors' opinion, the use of neurophysiological techniques complements the existing collection of marketing research approaches and methodologies and presents advances and improvements in marketing and consumer behaviour theories in relation to the study of branding and packaging.

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## CONFLICT OF INTEREST STATEMENT

Authors confirm that there is not any conflict of interest.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are upon request by writing to the corresponding author.

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