

UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

UNIVERSITY OF SARAJEVO
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MASTER'S THESIS

**A BIBLIOMETRIC ANALYSIS OF THE USE OF EYE-TRACKING IN
PACKAGING DESIGN**

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AUTHORSHIP STATEMENT

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ABSTRACT

In recent years, the application of neuromarketing techniques has gained increasing attention as researchers and practitioners seek to better understand consumer behaviour beyond traditional self-reporting methods. Among techniques, eye-tracking has emerged as a particularly valuable tool for capturing objective and measurable data on visual attention, decision-making, and emotional engagement with marketing stimuli. Packaging design, as a critical element of marketing communication, plays a central role in shaping consumer perceptions, influencing purchase decisions, and reinforcing brand identity. The use of eye-tracking to examine packaging elements provides unique insights into how consumers interact with visual cues such as color, typography, layout, and imagery.

This thesis employs bibliometric analysis to systematically examine the academic structure of research on eye-tracking and packaging design. By analysing publications found in the Web of Science Core Collection, the study identifies key trends, influential articles, thematic clusters, and the intellectual structure of this interdisciplinary field. Through this approach, the thesis contributes to a comprehensive understanding of how eye-tracking has been applied in packaging research, underlining both the evolution of the field and the directions it may take in the future.

The findings offer value to scholars by mapping the development of scientific contributions and to practitioners by clarifying the research areas that underpin evidence-based packaging design strategies. Ultimately, this thesis situates eye-tracking within the broader context of neuromarketing and consumer behaviour studies, emphasizing its role in advancing both theoretical knowledge and practical applications.

Keywords: Eye-tracking, Packaging Design, Neuromarketing, Consumer Behaviour, Bibliometric Analysis

Sustainable development goals



POVZETEK V SLOVENŠČINI

V zadnjih letih je uporaba nevromarketinških tehnik pridobila vedno večjo pozornost, saj raziskovalci in praktiki želijo bolje razumeti vedenje potrošnikov onkraj tradicionalnih metod samoporočanja. Med temi tehnikami se je sledenje očem izkazalo za posebej dragoceno orodje za zajem objektivnih in merljivih podatkov o vizualni pozornosti, odločanju in čustveni vpletenosti pri trženjskih dražljajih. Oblikovanje embalaže kot ključni element marketinške komunikacije igra osrednjo vlogo pri oblikovanju zaznav potrošnikov, vplivanju na nakupne odločitve in krepitvi identitete blagovne znamke. Glede na ta pomen uporaba sledenja očem za preučevanje elementov embalaže ponuja edinstven vpogled v to, kako potrošniki doživljajo vizualne dražljaje, kot so barva, tipografija, postavitvev in slike.

To magistrsko delo uporablja bibliometrično analizo za sistematično sledenje akademskim raziskavam o sledenju očem in oblikovanju embalaže. Z analizo publikacij, najdenih v zbirki Web of Science Core Collection, študija identificira ključne trende, vplivne članke, tematske grozde in intelektualno strukturo tega interdisciplinarnega področja. S tem pristopom delo prispeva k celovitemu razumevanju, kako je bilo sledenje očem uporabljeno v raziskavah embalaže, pri čemer poudarja tako razvoj področja kot tudi smeri, ki jih lahko zavzame v prihodnosti.

Ugotovitve nudijo dodano vrednost za znanstvenike z mapiranjem razvoja znanstvenih prispevkov ter praktikom z razjasnjevanjem raziskovalnih področij, ki podpirajo na dokazih temelječe strategije oblikovanja embalaže. Končno to delo umešča sledenje očem v širši kontekst nevromarketinga in raziskav vedenja potrošnikov ter poudarja njegovo vlogo pri napredovanju tako teoretičnega znanja kot praktičnih aplikacij.

Ključne besede: sledenje očem, oblikovanje embalaže, nevromarketing, vedenje potrošnikov, bibliometrična analiza

Cilji trajnostega razvoja



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1 INTRODUCTION

Understanding consumer decision-making has long been a central challenge in marketing. Traditional methods such as surveys, interviews, and focus groups have provided useful insights but are limited in their ability to capture subconscious processes that strongly influence behaviour (Hubert & Kenning, 2008). Neuromarketing has emerged to address this gap, combining neuroscience, psychology, and marketing to investigate the hidden drivers of choice (Ramsøy, 2015).

Among the various tools in neuromarketing, eye-tracking has become especially valuable. By recording gaze patterns, fixation points, and pupil movements, eye-tracking provides objective data on what attracts consumer attention and how visual information is processed (Zurawicki, 2010). This makes it particularly relevant for packaging design, which plays a dual role: protecting the product while also serving as a powerful marketing instrument that conveys brand identity, captures attention, and influences purchase decisions (Klimchuk & Krasovec, 2013). Elements such as color, typography, and layout often determine whether a product stands out or is overlooked in competitive retail environments (Spence, 2016).

Research on eye-tracking and packaging design has grown steadily, but the literature remains fragmented across disciplines such as marketing, psychology, and design (Wedel & Pieters, 2015). To gain a clearer picture of this evolving field, bibliometric analysis can be used to map its structure, identify the most influential contributions, and reveal the thematic clusters that have shaped its development (Donthu et al., 2021).

This thesis applies bibliometric methods to publications indexed in the Web of Science Core Collection, with the goal of examining how eye-tracking has been applied in packaging design research. In the first three chapters, neuromarketing, packaging design, and eye-tracking as the main three terms of this topic are analysed and presented in order to provide a thematic introduction of the bibliometric analysis. After those chapters the methodology is presented with its main focus on the bibliometric analysis and the objectives of the master thesis. Specifically, it seeks to (1) analyse trends in publication output, (2) identify the most cited and influential articles, (3) uncover the intellectual structure of the field, and (4) explore thematic connections between key research areas. By doing so, it contributes both to academic scholarship, by clarifying the evolution and structure of the field, and to practice, by highlighting how evidence-based insights from eye-tracking can guide effective packaging strategies.

2 NEUROMARKETING

2.1 Definition of neuromarketing

Neuromarketing is a field that combines neuroscience and marketing, focusing on understanding the correlation between consumer behaviour and decision-making processes. It explores how consumers subconsciously perceive various marketing stimuli, such as packing design. It is done with the help of neurological and physiological tools (Hubert & Kenning, 2008, p. 272). This method has gained popularity as it ignores traditional self-reporting techniques, which often suffer from bias or inaccuracy due to the constraints of human perception and expression. Consumer metrics techniques encompass various methods used to measure emotional, cognitive, and behavioural responses. These techniques include biometric measures such as electroencephalography (EEG), galvanic skin response (GSR), eye-tracking, and facial expression analysis, which allow researchers to quantify emotional engagement and cognitive load (Plassmann et al., 2012).

Since neuromarketing is focused on unconscious choice drivers of consumers, consumers are not aware of them. The drivers cannot be detected by the traditional methods such as social groups, questionnaires, focus groups, interviews, etc.. There are interpretations that the traditional techniques are becoming useless because of this, but it can also be interpreted as the improvements for traditional techniques (Ramsøy, 2015). The main goal is to use the neuroscience norms and methods and combine them with methods of disciplines such as marketing and economics. That combination brings the development and clarification of the marketing impact on consumer behaviour (Lim, 2018).

Since marketers and consumer behaviour researchers are interested in neuromarketing, several marketing strategies have been used in neuromarketing, and these strategies are being studied for quantitative evaluation from neuroscientific data. Neuromarketing is distinct from other marketing strategies since it goes straight to the consumer's brain rather than through their cognitive processes (Nemorin, 2017). Scientists are focusing more on the unconscious and emotional components of decision-making from the perspective of marketing (Bechara et al., 2005). While according to a neuroscience perspective, certain networks of cells in the brain's electrochemical activity are responsible for human cognitive, perceptual, and emotional activities (Cohen, 2012).

Essentially, neuromarketing is the marketing equivalent of neuropsychology in psychology. While neuropsychology investigates the relationship between the brain and

human cognitive and psychological functions, neuromarketing emphasizes the importance of viewing consumer behaviour through a brain lens (Bosak, 2013). The two primary types of neuromarketing stimuli have been promotions and products, both with and without prices. A product is any tangible good or service that satisfies customer needs. In neuromarketing, a product might be conceptual, like a 3D (three-dimensional) representation of the product, or physical, such as tasting a beverage. In neuromarketing trials, price is seen as a stimulation that is mixed with product or promotion. It has a significant impact on testing decisions of consumers to purchase or not purchase the goods (Dapkevičius et al., 2009).

2.2 History of neuromarketing

The term "neuromarketing" refers to the intersection of two academic disciplines. The term neuromarketing cannot be identified to a specific individual because it emerged organically about 2002 when few U.S. corporations, like Brighthouse and SalesBrain, were the first to offer neuromarketing research and consulting services that suggested the use of technology and information from the field of cognitive neuroscience (Bosak, 2013). Many traditional economic and marketing models presented the conscious and rational cognitions of customers as the most important ones in terms of purchase decisions (Thompson, 2013).

In 1999 the first functional magnetic resonance imaging (fMRI) study was used for marketing research by Zaltman (1997). The term "Neuromarketing" was used for the first time in 2002 by Professor Ale Smidts, from the Rotterdam School of Management of the Erasmus University. It was mentioned while presenting the use of neuroscience approaches in the field of marketing (Iloka & Onyeke, 2020). The first scholarly piece of neuromarketing research was conducted by Read Montague, Professor of Neuroscience at Baylor College of Medicine, in 2003 and published in *Neuron* in 2004. The study invited participants to drink either Pepsi or Coca-Cola while their brains were examined using fMRI equipment (Morin, 2011).

It is natural to suggest that, when evaluating and comparing stimuli, people will favor more agreeable ones over less pleasing ones, and that, in the case of two mentioned sugary drinks, the one that tastes better subjectively is the most pleasing. This viewpoint provided the most straightforward model linking reported behavioural preferences to reward-related brain responses. 67 participants took part in the study. Dr. Montague was unable to explain how brain processes product and brand preferences. However, the study did show that

whether or not people are aware of the brand they consume, various areas of their brains light up. The research also provided new significant findings such as that big brands can affect executive functions. It was discovered by having the frontal cortex, which does most of humans thinking, lighten up for people that were drinking Coca-Cola and they expressed themselves as they prefer Coca-Cola rather than Pepsi. But there were cases where while those that chose Coca-Cola chose Pepsi while tasting without knowing which drinks they are drinking. The reason for that is because while not being aware of decisions, the frontal cortex and executive functions are less active and less important in decision making (McClure et al., 2004). This study proved to many marketing researchers that there is huge potential in the neuromarketing science field (Morin, 2011).

Besides the study presented a huge potential of neuromarketing, it also brought negative comments and articles which were the first obstacles of the science field. Those negative comments were discussing how the fMRI is being exploited by marketing consultancy companies in order to create exact marketing strategies that will bring sales success. It was discussed that the cognitive science is not that improved to exactly predict human decision-making in the real world, and that companies that are willing to invest a lot of money for their campaigns need to be more informed about the technology of fMRI and its limitations (Brammer, 2004).

Of course, there is nothing wrong when scientists are using technology to improve marketing and commercial interests (Eaton and Illes, 2007). But the parts where the inner parts of human body are examined can be seen as problematic (Murphy et al., 2008). The responsibility of scientists that implement the results of neuromarketing studies is difficult to define, and at the moment there are no laws or restrictions that could stop the abuse of study findings that exclusively serve financial interests (Bercea, 2015). There are two main types of problems that may occur in terms of neuroethics. The first one is the risk of harming or exploiting various individuals or parties while the second one is affecting the consumer autonomy (Murphy et al., 2008).

As a result of mentioned concerns, back in 2002, a meeting called Neuroethics – Mapping the Field was held (Marcus, 2002). The term neuroethics has been used to describe the ethical issues related to the neuroscientific foundations of ethical behaviour (Roskies, 2002). The main focus of neuroethics were the scientific questions about what kinds of data can be obtained and analysed with certain techniques and what are the limits of usage of those techniques (Roskies, 2016).

Such metrics provide vital insights into how customers react to packaging and other promotional elements, they are especially used for improving customer satisfaction and increasing the purchase possibility. Neuromarketing is analysing human cognitive reactions and responses to various marketing stimuli (Dooley, 2010). Even though marketing research has a major focus on brand choice (Jacoby et al., 1974), and integrated methods are growing, few of these methods rely on neuroscientific tools (Van der Laan et al., 2015). Neuromarketing is an interdisciplinary field that integrates components of neuroscience, neurology, and psychology with concepts of consumer behaviour to explain the triggers of buyers while making their buying decisions (Marichamy et al., 2014).

2.3 Neuromarketing techniques and methods

Neuromarketing employs a variety of techniques and methods to analyse consumer behaviour and emotional responses to marketing stimuli. These methods provide insights that traditional market research techniques often cannot capture. The techniques can recognize the focus of human consumer attention and provide sensory experience measures (Ćosić, 2016).

Traditional survey methods are replaced by neuromarketing, which uses non-invasive brain signal recording techniques to measure a customer's brain response to marketing stimuli (Vecchiato et al., 2011). The development of neuroscientific tools made researchers use cutting-edge technology in marketing research, such as eye-tracking (ET), functional magnetic resonance imaging (fMRI), electroencephalography (EEG), galvanic skin response (GSR), electromyography (EMG), etc. (Alsharif et al., 2023b). The devices use neural activity from the brain to investigate a customer's cognitive and emotional reactions (like/dislike, approach/withdrawal). In the human brain, various stimuli trigger corresponding responses, which can be monitored by tracking changes in brainwaves or neuronal signals (Custdio, 2010). The neuromarketing techniques can also investigate our memory and learning processes. They have the ability to connect with our emotions and motivation, which are some of the most significant marketing targets.

All mentioned techniques have advantages and limitations, and they are frequently used to measure complimentary variables in order to better understand marketing problems. To achieve an effective outcome with neuromarketing technology, it is recommended and productive to apply combination of techniques. There are three types of neuromarketing techniques: those that measure the metabolic activity in the brain or related to it, those that

measure electrical activity in the brain and those that do not measure brain activity (Fortunato et al., 2014).

2.3.1 Functional Magnetic Resonance Imaging (fMRI)

Functional magnetic resonance imaging (fMRI) has improved marketing research by offering deeper insights into consumer behaviour compared to traditional methods (Sánchez-Fernández et al., 2021). This was significant because the functional magnetic resonance imaging detects brain activity through changes in blood flow. The high spatial resolution allows researchers to identify brain responses to marketing stimuli (Alsharif et al., 2023a). Magnetic resonance scanners create tomograms of the brain by capturing weak but identifiable resonance signals released by tissue water in a strong magnetic field after being excited by high frequency electromagnetic pulses (Kenning et al., 2007). With the usage ratio of 70% among others, the fMRI is the most used technique in neuromarketing and consumer behaviour studies (Kable, 2011). The fMRI data can also predict the success of a marketing campaign and suggest personalized marketing strategies based on individual neural responses (Pilelienė et al., 2022).

It is important to state that all neuromarketing techniques have their own limitations (Mileti et al., 2016). The first and most important limitation are the high prices of neuroimaging tools such as the fMRI. The cost of one hour is \$500 (Perrachione et al., 2008). This is something that leads to avoiding the techniques or forming constraints for the usage time. In addition to providing a measurement of brain activity during the completion of a task, fMRI results enable inferences to be made in reverse from brain activation to brain function. This can lead to false result presentation (Reimann et al., 2010).

2.3.2 Galvanic Skin Response (GSR)

The galvanic skin response (GSR) measures changes in skin conductance, which can indicate emotional arousal in response to marketing stimuli. When individuals experience heightened emotions, the activity of their sweat glands increases, making the skin a better conductor of electricity. This physiological response is recorded using a galvanometer and can be used to quantify nonconscious reactions to marketing messages (Ohme et al., 2009). GSR is a valuable complement to traditional techniques, as it helps to understand consumer emotions, cognition, and behaviours from a holistic perspective.

The body contains two types of sweat glands: eccrine and apocrine. The eccrine sweat gland regulates body temperature and is controlled by the sympathetic nervous system. As a result, it is safe to assume that the scope of the report will begin with the eccrine sweat gland, which can be found on the palms, soles of the feet, and forehead. Apocrine sweat glands, which generate involuntary sweating, are found in the armpit and groin. Eccrine sweat gland activity increases in response to emotions such as sadness, fear, and joy. Both positive and negative emotions might trigger increased sweat gland activity. There are two main parts to GSR signals, namely SCL (skin conductance level) and SCR (skin conductance response). The tonic level, or Skin Conductance Level (SCL), has to do with slow-acting substances (Response, 2017).

2.3.3 Eye Tracking (ET)

ET measures where the person is looking (gaze or fixation point), the time that this person looked at this certain point, the movement of his eyes in relation to his head, pupil dilation, and the number of blinks (Zurawicki, 2010). In addition to the fixation, the sequence in which his or her eyes shift from one location to another (saccade) can also be evaluated (Chae & Lee, 2013). There are different ET technologies to measure eye movement and the most common are those that measure the observation of controlled stimuli at fixed points in videos, photos, and user's interaction with a computer screen. There are more advanced devices that also automatically track the head position in three-dimensional space in relation to the camera (Zurawicki, 2010). This makes the measurement process more subtle, with very little or no interaction between the researchers and their subjects. The main limitation is that the studies for the eye-tracking need to be done in laboratories (Bielikova et al., 2018). A study on the impact of information processing among users of digital video recorders, showed that having the studies in laboratories excludes the external disturbances which are an important factor for more precise eye-tracking results (Siefert et al., 2008).

2.3.4 Electrocardiogram (ECG)

Some Neuromarketing research employed heart rate as a metric to assess consumer emotion and attention while viewing TV commercial stimuli. Heart rate is the speed at which the heart beats and is normally evaluated using an electrocardiogram (EKG). An EKG uses external skin electrodes to monitor the electrical activity of the heart. Two opposing neural systems regulate heart rate: the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). The sympathetic nervous system controls the

body's automatic response to environmental stimuli. Activation of this system raises heart rate, resulting in fight or flight mode, which is an independent measure of arousal. The parasympathetic nervous system, on the other hand, regulates the calm and relaxed state, which is distinguished by a slower heart rate. Slower heart rate in response to a commercial indicates increased focus on the ad, therefore providing an independent measure of attention (Baldo et al., 2015).

2.3.5 Electroencephalography (EEG)

EEG is an electrophysiological method to record the electrical activity of the brain by attaching several electrodes (electrical conductors) along the scalp (Haas, 2003). EEG measurements are considered useful for their high temporal resolution and ability to adapt traditional experimental designs into neuroscience experiments (Jordão et al., 2017). EEG signal assessment can quickly detect changes in brain activity, assisting in understanding both unconscious and sensory reactions of customers. Neuromarketing addresses the challenge of customer heterogeneity, which influences preferences and decisions. Heterogeneity may derive from age, gender, biological factors such as hormones and DNA, as well as physiological factors (Khurana et al., 2021).

3 PACKAGING DESIGN

3.1 Definition of packaging design

Packaging design can be defined as the connection of structure, materials, form, imagery, color, typography, and regulatory information with design elements to make a marketing-suitable product (Klimchuk & Krasovec, 2013). It involves several considerations ranging from protecting package contents to articulating and communicating desired brand impressions (Orth & Malkewitz 2008). However, good packaging should not only ensure product safety and convenience, but also enhance overall consumer experience.

Packaging is glass, wood, plastic, fabric, paper, ceramic or metal that serves as a protective layer around the product, facilitating its transportation and ensuring that it reaches the consumer in the most appropriate way (Polat, 2022). The main goal of packaging design is to develop a container that protects, holds, stores, transports, dispenses, and differentiates a product. It should also help identify the product in the market. Ultimately, packaging aims to support marketing efforts by clearly conveying the product's character or purpose and encouraging purchases (Klimchuk & Krasovec, 2013).

The ways people packed goods, as well as packaging design, developed as the years and centuries went by. The designs evolved from simple materials such as leaves and animal skins, all the way to luxurious and outmost practical solutions (Berger, 2003).

Advancements in materials (for example, the development of recyclable thin-film soft electronics enabling the creation of smart packaging solutions) manufacturing techniques, as well as the needs of the consumer, are shaping packaging into an important aspect of product identity, marketing, functionality, as well as sustainability (Carneiro et al., 2023). As people traveled globally, transporting goods over long distances became essential, creating the need for vessels to carry them. Widely traded items included textiles, metals, perfumes, wine, spices, and later, coffee and tea, which were exchanged along early intercontinental trade routes, most notably the Silk Road (Ma, 1998). This extensive trade led to the development of diverse packaging methods to store, protect, label, and distinguish products throughout their journey (Klimchuk & Krasovec, 2013).

The invention of the first printing press goes hand in hand with the development of packaging design. As Johannes Gutenberg developed the printing press in 1430s, inspired by the medieval paper press, which was modelled after the ancient wine-and-olive press of the Mediterranean area. A long handle rotated a heavy wooden screw, applying downward pressure on the paper placed over the type set on a wooden platen. (Britannica, 2025). Between 1500 and 1600, European cities where printing presses were established in the 1400s grew 60% faster than otherwise similar cities (Dittmar, 2011).

The first man to demonstrate the practicability of movable type was Johannes Gutenberg (Kreis, 2016). His printing press played an important role in this process, as in the 1500s, Andreas Bernhart, became one of the first tradesmen that printed his name along with a decorative design on paper wrappers for his products, pointing out the way to merchandising with printed designs (Klimchuk & Krasovec, 2013). Skipping a few centuries, the Industrial Revolution introduced mass production, increasing the need for standardized and efficient packaging. Packaging's industrial revolution played a key role in the development of modern marketing. (Twede, 2012). This surge was driven by the mass production of goods, necessitating improved packaging solutions. However, many of the newly developed materials were costly and primarily used for luxury products.

One major development during this period was Napoleon's Food Preservation Prize (1795). Napoleon Bonaparte offered a reward of 12,000 francs to anyone who could

develop a better method of preserving food for his army. It took 15 years for Nicolas Appert, later known as the father of canning, to claim the prize, as he pioneered a technique of boiling food and sealing it in airtight glass containers, a method that remains widely used today (Francis, 2000). Another breakthrough was the rise of tin in food preservation. In 1810, Peter Durand patented tin-coated iron cans as an alternative to bottles. Over the next two decades, tin became a preferred packaging material, especially for products like cookies and tobacco (Holcomb & Twede, 2003).

The first cardboard box appeared in 1817, introduced by Sir Malcolm Thornhill. While cardboard had been invented earlier, "*...the corrugated material used in these boxes wasn't created until 1871.*" Early cardboard boxes were mainly used to transport silk moths and eggs from Japan to Europe (Meghana et al., 2023). The 19th century saw the rise of new materials and machinery, which led to the rapid industrial growth of packaging production. This development reflected the level of civilization, aligned with societal standards, and responded to the needs of the time (Bolanča et al., 2018).

The late 19th century marked the advent of branding and mass marketing in packaging design. Originally, packaging's primary function was to protect the product, but it soon evolved into a crucial sales tool, helping to attract attention, describe the product, and facilitate the sale (Kotler et al., 1998). This shift in packaging's role coincided with the discovery of bacteria in the 20th century and the growing understanding that exposure to air accelerates food spoilage. As a result, packaging was further developed to protect products from oxygen and other gases, ensuring their preservation (Polat, 2022). Since the early 20th century, plastics quickly replaced other packaging materials like glass and paper because of its synthetic composition, high production efficiency, superior barrier properties, strong mechanical durability, and versatility (Dey et al., 2021).

Companies have begun to recognize the potential of packaging as a communication tool, and now, they focus on using it to build and sustain a strong market presence. Packaging serves as a key interface between the brand and the consumer, playing an important role in the purchasing decision (Bloch, 1995). Since the early twentieth century, plastics quickly replaced other packaging materials like glass and paper because of its synthetic composition, high production efficiency, superior barrier properties, strong mechanical durability, and versatility (Dey et al., 2021). The mid-20th century witnessed the rise of plastics, impacting packaging design. Materials like polyethylene, introduced in the 1930s, became dominant in food packaging due to their versatility and cost-effectiveness (De Santis et al., 2024).

This era also saw the emergence of single-use and disposable packaging, aligning with the growing culture of convenience and consumerism. Single-use plastics are typically used for only a short period, anywhere from a few hours to a few weeks, resulting in a serious environmental waste issue. (Surendren et al., 2022). In spite of its many benefits, plastic material lacks biodegradability, causing it to persist in the environment without significant weight loss. It can be suggested that replacing non-recyclable single-use plastics and controlling the improper use of single-use packaging materials could lead to positive changes. (Dey et al., 2021)

3.2 Importance of packaging design in marketing strategy

Packaging has become a primary vehicle for communication and branding (Rettie & Brewer 2000). While received wisdom suggests that higher creativity enhances consumer engagement (Smith et al., 2007), the opposite effect may occur if customers must invest significant emotional and cognitive effort to interpret creative elements (Zimmerman & Shimoga, 2014). A notable example is Dove's launch of limited-edition bottles designed to reflect different body types, which, rather than engaging consumers, was perceived as offensive by many (Luttner, 2017). Cases like this in the retail packaging sector indicate that varying degrees of creativity in packaging can lead to different consumer reactions.

However, the impact of low versus high creative cues on customer persuasion, cognitive processing, and responses remains largely unexplored. This knowledge gap is particularly relevant for brand managers and retailers, as understanding how consumers interpret and react to creative packaging could directly influence marketing strategies and purchase decisions (Shukla et al., 2022). When packaging design is not properly prioritized, various issues can arise, such as inadequate product protection, excessive use of materials, lack of appeal to attract first-time buyers, and poor functionality for consumers. Packaging is often seen as an extension of the product itself, as it plays a key role in the product's success by preserving shelf life and enhancing usability (Bix et al., 2004., p. 4).

A marketing mix includes multiple areas of focus as part of a comprehensive marketing plan. The term often refers to a common classification that began as the four Ps: product, price, placement, and promotion (McCarthy, 1960). Successful marketing encompasses multiple elements rather than concentrating on a single message (Kotler & Keller, 2016). This approach allows businesses to connect with a broader audience while ensuring that key priorities remain central. By considering the four Ps, marketers can make informed

strategic decisions when introducing new products or refining existing ones (Kenton, 2024).

Consumers draw important information about the product and its attributes from the package's aesthetic and graphic design. This suggests the ability to persuade people at point of purchase, although that competitive environment is a challenging one. The importance of communicating appropriate product and brand signals on packaging is considerable as well as achieving the level of visual stand out (Moskowitz, et al. 2009). For example, higher quality products, fancy packaging, exclusive store locations, higher retail margins, expensive promotions, advertising campaigns, and brand names all contribute to the higher prices of luxury goods. In fact, if luxury products are not priced high, they lose their rarity and exclusivity characteristics (Dubois & Duquesne, 1993).

The role of packaging is perhaps of greatest importance in consumer packaged good (CPG) markets (Steenis et al., 2017), therefore, understanding how consumers perceive products based on packaging design is essential for identifying the most relevant design cues. These cues influence consumer perception of food products and shape their expectations regarding packaging information. The perceived characteristics of packaging, especially in packaged food products, are often associated with the product itself, creating a variety of perceptions in consumers' mind (Pinya & Mark, 2007). Identifying key elements can help create packaging that is visually distinctive, effectively communicates product benefits, and aligns with consumer needs, ultimately enhancing product satisfaction (Gelici-Zeko et al., 2012).

Packaging design is very influential because of its pervasive impact and its presence in the purchase situation (Orth & Malkewitz, 2008). Packaging can attract consumer attention towards the product and it can influence the consumer perception about that particular product. Once a consumer is attracted towards your products there are many possibilities that he may purchase your product (Rundh, 2005). Packaging plays a crucial role in customer experience, influencing trial, satisfaction, and repeat purchases, particularly for consumer non-durables and even some durables. Poor packaging design can lead to product damage, waste, shorter shelf life, and diminished quality, ultimately causing customer dissatisfaction and negative word-of-mouth (Bix et al., 2004).

When packaging design or label information creates expectations that do not align with the actual product experience, consumer attitudes may be influenced positively or negatively.

If the product exceeds expectations, it can lead to a favorable perception, whereas a disappointing experience may result in negative feedback (Deliza & MacFie 1996). This highlights the significant role of packaging design and labeling in shaping consumer acceptance of food products, often outweighing the product's actual characteristics. However, this does not imply that product attributes, particularly sensory qualities, are irrelevant (Grunert, 2000). Attracting initial purchases is not enough for sustained product success, as *“the product/package system must generate satisfaction,”* or it risks discouraging repurchase. Packaging that is difficult to open or features unreadable labels may drive consumers toward alternatives that prioritize user-friendly design. Brands that fail to consider these factors may struggle to retain customers in competitive markets (Bix et al., 2004).

Packaging does play an important role in preserving the product, however, there is a major disadvantage of packaging - it adds to the world's environmental footprint because it is always discarded immediately after the product is used (Magnier & Schoormans, 2015). In the last few decades, there has been an increased interest in sustainability overall, which includes sustainable packaging as well. Sustainable packaging has been defined as a packaging with a relatively low environmental impact based on life-cycle assessments (LCA) (Glavič & Lukman, 2007). To increase consumer acceptability and purchase of sustainable packages, a detailed understanding of their opinions and perceptions of environmentally friendly packaging is needed (Magnier & Schoormans, 2015).

Unfortunately, once packaging has served its purpose, it becomes waste that can significantly harm the environment, particularly single-use packaging and those made from mixed materials. To address this, specific laws have been introduced to promote an environmentally and socially responsible packaging industry (Kozik, 2020, p. 2-3). A significant shift towards sustainability has led to the adoption of eco-friendly materials, with a notable trend being *“paperization.”* This involves replacing traditional plastic packaging with paper-based alternatives. For example, companies are developing fiber-based solutions to substitute plastic shrink wrap for multipacks, thereby reducing plastic waste (Pyzyk, 2024). Additionally, the exploration of seaweed-based materials offers biodegradable options that can decompose more readily than conventional plastics, addressing environmental concerns associated with plastic pollution (Pyzyk, 2024).

Color stands out as a crucial visual cue among those perceived by consumers, significantly influencing their perceptions and decisions (Spence, 2016). When consumers scan store shelves, the color of product packaging is often the first detail they notice, standing out

more than other packaging elements. In retail, color plays a crucial role in communicating messages about the brand, product, environment, and origin (Sekki & Kylkilahti, 2023). Because of that, a good choice of color for packaging can affect the initial impression of the product, and consequently, the consumer's purchase decision.

Color is a basic design element that emerges as a result of the impact of light on objects and surfaces. It has the further capacity to retain attention, which enables cognitive information processing (Schoormans & Robben, 1997). Color perception encompasses various aspects, including the physical properties of objects that influence color appearance, the role of photoreceptors in the eye, the processing of color information within the visual system, the genetic basis of color vision, common color vision deficiencies, cultural differences in color terminology and categorization, the phenomenon of color constancy, variations in perceived color under different viewing conditions, color vision capabilities in animals, and the evolutionary development of color vision (Byrne & Hilbert, 2003).

Colors make everything around us visible thanks to light. Light, surface, eye and brain provide this process of appearance. A number of features of human color vision can be explained on this basis including the well-known fact that any light can be matched in color by suitable combinations of three appropriately chosen primaries (Hilbert, 1992). It is physiological for the light to reach our brain by hitting various places and refraction in the eye, but the perception of our brain is a psychological event. Colors with proven effects on people are used to evoke many emotions (Ozcan & Kandirmaz, 2021). Over the past few years, researchers have become increasingly interested in colors and their impact on psychological functioning (Kumar, 2017). Colors have a direct impact on the subconscious, influencing emotions, behaviours, and moods while also evoking feelings of attraction or aversion (Hunjet & Vuk, 2017).

The color red stimulates a purchasing impulse and is commonly linked to chocolate, while green and brown create a perception of natural products. Black is often associated with death and is also connected to official institutions, particularly in examinations involving cars. Additionally, red is linked to spicy flavors, and green is perceived as representing fresh tastes (Ozcan & Kandirmaz, 2021). Individuals' responses are highly consistent, indicating a narrow range of variability. This uniformity suggests that colors evoke specific emotional responses that directly influence consumers' decisions (Singh, 2006). Findings underscore how important the role of color in shaping consumer behaviour is (Ozcan & Kandirmaz 2021, p. 27).

4 EYE-TRACKING METRICS

4.1 What is eye-tracking

Human eye movements have long been studied, but it wasn't until the middle of the 1970s that it became possible to actually track and examine them. The creation of eye-tracking techniques and methodology, which are now widely employed in various fields of human activity, marked the beginning of the true breakthrough in that kind of research (Duchowski, 2017). Eye tracking is a useful method for the better understanding of people's behaviour based on their eye movements (Campos, 2017). Using eye-tracking device makes possible to view different brands through the eyes of the eventual customers which opens a lot of possibilities for marketing studies (Iloka & Onyeke, 2020). Fixation and saccades are main techniques used to measure eye movements (Velásquez, 2013).

Fixation explains fixation of eyes to an object and object's details and saccades are the rapid movement of the eye between two fixations (Nielsen et al., 2010). The focussed visual area provides detailed information, whereas peripheral vision is used to identify the target. Researchers are interested in the association between saccades and peripheral vision. The constraint is that people must hold their eyes fixed or be supplied with a tachistoscopic stimulus for a brief amount of time for eye movement to occur (Thite et al., 2015). Saccades are also described as the movements of someone's eye from one point to another (Wook Chae et al., 2013). During saccades (30-50ms), the visual system's sensitivity decreases significantly (Richardson et al., 2004). To initiate a visual stimulus change during a saccade, a saccade must be detected within milliseconds of its commencement after which a computer calculates the relevant stimulus change and refreshes the screen (Richardson et al., 2004).

Human factors and ergonomics, computer science, neurology, psychology, psychiatry, and psycholinguistics, as well as usability, industrial engineering, marketing (market research), advertising, and gaze-based interaction, are just some of the fields that use eye trackers (Duchowski, 2017). The eye-tracking technique also measures different points such as the fixation or gazing point, the time that the person stared at the point, eye movement with the head, number of blinks, and dilation of the pupil (Zurawicki, 2010). The continuous monitoring of pupil dilation as an indicator of emotional arousal is a less common use of eye tracking (Bradley et al., 2008).

The movements measured by eye-tracking techniques suggest hidden attention systems that communication researchers cannot directly assess (Hoffman, 1998). These measurements can be of great value for marketers (Iloka & Onyeke, 2020). It is also possible to control stimuli at fixed points in photos, videos, and other interaction that users have via a computer screen (Iloka & Onyeke, 2020). Some technologies are constructed to make possible tracking the head's movement in a three-dimensional space based on an attached camera (Zurawicki, 2010).

The biggest advance of these techniques is limited or no interaction between the person whose response is investigating and the investigators (Iloka & Onyeke, 2020). Today, many applications are used in making selection of focus in an image, by making standard of attention with the most significant interest (Zhao et al., 2013). In that context, information about objects that attracts attention that are related to visual fixation patterns can be provided by eye-tracking techniques (Fizman et al., 2013).

Other types of techniques, especially those that measure cognitive responses and tools connected to facial coding can be used together with eye-tracking techniques. Facial coding measures visual activity which is the exact point the person is looking at, making possible to evaluate people's feeling based on what they have seen by linking emotional responses to different stimulated elements (Iloka & Onyeke, 2020). Linking the emotional responses with the visual focus is providing important information on the understanding of the factors driving customers' reaction towards a given stimulus (Hill, 2010).

4.2 Eye-tracking metrics as visual attention measure

In order to differentiate brand's quality, customers make decisions based on the ability of products or packaging to break through the clutter of visual information and is able to attract visual attention (Pieters et al. 2002). Visual attention is defined as a selective focus or spotlight of the central eye-sight that is following scan-path over the stimulus, that consists of fixations and saccades (Hubner et al., 2010). There are two parts of eye fixations, the first (initial) called noting and the second called reexamination (Chandon et al., 2009). Reexamination is a fixation centred on the object which gives higher level of details examination (Chandon et al., 2009).

Previous eye-tracking studies have illustrated that eye fixations, rather than peripheral vision, increase memory of the objects of fixation (Pieters et al., 2002). It is found that

slow eye movements between brands led to additional brand purchases within a category, highlighting that the time buyers spend on the first choice is a key driver for additional purchases (Bigne et al 2016). Consumer values are also important reasons for dedicating attention to objects in the visual aspect. (Krajina 2019). In a historical context, visual attention is described as closely connected to action or how people react to visual attention (Gibson, 1941).

Consumers degree of focusing on specific stimuli represent attention from the consumer perspective (Krajina 2019). According to consumers behaviour perspective, attention can be divided into goal-directed attention and stimulus-driven attention (Bialkova & van Trijp, 2010). Goal-directed attention is attention directed toward a stimulus because it is meaningful to the consumer's goals while stimulus-directed attention is an attention directed the stimulus that is highlighted as particularly salient within the visual field (Bialkova & van Trijp, 2010).

Further on, visual attention was described with two aspects; orientation and discover (Posner et al, 1980). Orientation attention was described as an unselective search process that works fast and enables simultaneously procession of many stimuli and happens before the discover-attention which is slow process related to one stimulus at a time (Posner et al, 1980). Orientation attention is related to the peripheral eyesight (the parafovea area of retina), and discover attention is related to the central eyesight (the fovea area of retina) (Posner et al, 1980). According to these two aspects of attention, customer can search the shelf in the supermarket for a specific packaging perceiving several visual impressions, but if the preferred product or if another interesting packaging is notice people shift to serial search, focusing on particular features like packaging attributes and details (Clement et al., 2013). Allocation of visual attention to specific location by the focus area and spotlight of the attention, causes that products at that position are processed more intensively (Hubner et al., 2010). Contrary to these assumptions, some buyers may recall more brand names but note only fewer brands on the shelves (Chandon et al., 2009).

Different to early theories of attention as passive and conscious, new theories showed that persons are not aware of their eye saccades and fixations (Clement et al., 2013). Considering later research it is concluded that visual attention and awareness are distinctive but still related terms, where attention plays an active and constructive role in the decision-making by improving visual processing and modulating perception (Lamme, 2003; Orquin & Loose, 2013). Active role of visual attention in the decision making process made a change in understanding analogy of visual attention from a 'spotlight' to a

'zoom-lens' (Eriksen & James, 1986). According to these findings visual attention is more dynamic and flexible comparing to the earlier findings. Further on, visual processing is proposed to be divided into pre-attentive and attentive stages (Neisser, 1976).

Pre-attentive mechanisms rapidly transform the visual input and make the image coherent. Pre-attentive mechanisms mostly are not sufficient, and visual attention is activated in order to integrate different characteristics of a product like motion, color and shape (Spekreijse, 2000) Orientation, evaluation and verification are three stages recognised as processes in a laboratory simulation of supermarket shelving (Russo and Leclerc, 1994). Orientation is an overview of the product display and evaluation is the longest stage that deliberately evaluate other similar products. Another author differentiate four phases including first attention, further attention, 'product-in hand attention' and post-purchase attention (Clement, 2007).

Overload of visual information caused by large amount of products may have a negative impact on decision making process (Iyengar & Lepper, 2000). Consumers simplify decision making process when exposed to too many products (Fasolo et al., 2003). These reactions to too many informations provide by large amount of products indicates that search strategy is continuously influenced by visual impact (Clement, 2007). It is shown that the number and position of product has a strong impact on visual attention and brand evaluation.

Since greater details of a product needs centred fixation of consumer's sight on that object, products placed close to the center get the biggest attention, which emphasise the importance of differentiation between the attention and evaluation phases in examining in-store marketing (Chandon et al. 2009). In this respect, eye-tracking is accepted as a measurement of visual attention, while surveys that rely on parameters based on memory are not considered as appropriate (Bielikova et al., 2018 Chandon et al., 2009; Clement et al., 2013). On the other side, some studies report that survey results correlate with the brain imaging data that support efficacy of using for combined analysis of behavioural and survey methods. (Reimann et al. 2010).

4.3 The use of eye-tracking techniques in packaging analysis

According to relevant research, the product must be "sufficiently distinctive" from competing options in the category in order to draw attention. Visual attention is mostly

dependent on originality and divergence from recognized information (Garber et al., 2000). There are several studies about the use of eye-tracking in packaging analysis and their primary objective is to determine the parts on packaging that capture user attention (Rebollar et al., 2015). It is also important to underline that the new packaging design can also be perceived as too distinctive (Schoormans & Robben, 1997). The main goal of the use of eye-tracking in packaging analysis is to forecast the response of a potential buyer (Tonkin et al., 2011). There is a positive relationship between the degree of deviation of packaging design and attention. The study of Schoormans and Robben from 1997 is also important because it emphasizes how crucial categorization procedures are and how packaging category deviation is related to the evaluation itself. The eye-tracking technique determines this by analysing the number of fixations on each packaging part, the time of viewing, and the time that a potential consumer needs until viewing certain areas (Rebollar et al., 2015).

There are also points of views that consumers prefer products that are prototypes within a category range of products no matter what the packages are (Barnes & Ward, 1995). However, customers and potential buyers will pay more attention to packaging designs that differ from the product prototype than to the ones that are similar to designs of prototypical products (Husić-Mehmedović et al., 2017). The use of eye tracking for packaging design hardly reaches any limitations as it does not depend on the memory and sensory abilities of potential buyers while it collects objective data on behaviour in a fast and more discreet manner when a visual stimulus is shown to them (Graham et al., 2012).

It is very important that experts examine the customer attention and product evaluation from the aspect of the package design, within the product category competition (Husić-Mehmedović et al., 2017). Attention recognition has a crucial role in defining and interpreting the decision-making processes (Krajina et al., 2021). However, it is unclear whether and how proto-typicality differs from similarity, which has also been shown to influence product evaluation and attention (Husić-Mehmedović et al., 2017). Unique commercials attract a lot more of public attention to the product that is being promoted (Pieters et al., 2002). Goal oriented attention, stimulus-driven attention, and the mix of both are three different study attention types in the use of eye-tracking for packaging analysis (Rebollar et al., 2015).

Additionally, there is a significant correlation between product preferences and expertise with product design (Cox & Cox, 2002). Businesses like Kraft Foods, PepsiCo, and Unilever frequently using eye-tracking to create innovative packaging and retail strategies,

but the public is not able to access their methods or findings (Wedel & Pieters, 2008). These are the results of packaging designs that are unique and familiar. The inclusion of evaluative elements in the suggested research design is further supported by the inconsistent relationships between significant attention factors, such as familiarity and categorical deviation, and their effects on further evaluation (Husić-Mehmedović et al., 2017).

When there is a clear recognition of a brand at a packaging of a product the packaging design had less impact, but when a brand is not in the focus of different packages of a product, the design is crucial in the buying decision (Orth & Malkewitz, 2008). It is crucial to state that most of the relevant studies focus on evaluation of brand or on product choice and only very few are focusing on the packaging design (Clement, 2007). Product buying decisions are dependent on brand strength recognition and packaging design as the visual equity (Chandon et al., 2009). By avoiding packaging design analysis, important facts are being avoided in the analysis that are significant for the evaluation of stimuli.

The goal-oriented attention eye-tracking technique is focused on detecting which packaging parts have user attention when they are carrying out a specific task (Kessel & Ruiters, 2012). Perceived product quality and brand preference are influenced by attitudes regarding visual packaging design (Wang, 2013). This can be associated to the goal-oriented type of attention since a potential consumer is looking for a better product with more quality based on the packaging design (Rebollar et al., 2015). Researchers have no insight into possible evaluation transfer from package to a certain product when there is no package evaluation information. However, there have been conflicting reports regarding the relationship between visual marketing stimuli evaluation and attention (Husić-Mehmedović et al., 2017).

The majority of extravagant packaging designs may receive a poor rating (Schoormans & Robben, 1997). The stimulus-driven attention eye-tracking technique studies the areas on a packaging that draw a user's attention when they are not required to perform a particular activity, paying attention to stimuli (Clement et al., 2013). The evaluation of packaging design is presented as positively related to consumer attention in some papers (Kumar & Garg, 2010). More recent research papers state that packages with aesthetic designs lead to attention and positive product decision making (Reimann et al., 2010). This is an example of a result of a stimulus driven eye-tracking technique analysis because potential buyers are focused only on the esthetics (Rebollar et al., 2015). Even though they cost more,

consumers find products with attractive packaging to be more satisfying and preferable to those with well-known brands in standardized packaging (Reimann et al., 2010).

5 BIBLIOMETRIC ANALYSIS

5.1 Methodology

The methodology that is applied in this study is based on the bibliometric analysis is carried out through the Web of Science (WoS) Core Collection (CC) platform, searching all relevant publications until and including the year 2024. Bibliometric analysis is a quantitative approach for the description, evaluation, and monitoring of published research (Dzikowski, 2018, p. 281). It implements statistical methods for the research of bibliographical data which forms databases of specific scholarly areas (Bellis, 2009). The main goal of this thesis is to answer the four research questions from the synopsis. The bibliometric analysis data is massive and written in an objective manner, with many data such as publications, citations, keyword occurrences, etc. The interpretation of the bibliometric analysis is objective but it can also be subjective and it will contribute to answers to research questions (Donthu et al., 2021).

The four proposed research questions are:

1. What is the current publication trend in the fields of eye metrics and packaging design?
2. What are the most cited and influential articles that informed research on eye metrics and packaging design?
3. What is the intellectual structure of current research on eye metrics and packaging design?
4. Which themes exist in the field of eye metrics and packaging design and how they relate with each other?

The analysis involves retrieving data from the Web of Science (WoS) database. Topics that were selected for the formation of the dataset were “eye-tracking” or “eye tracking” and “packaging design” or “package design”. The “or” options were used to include synonyms and different keywords with identical meaning in order to get a more accurate view of the research area. There were many categories and fields to choose for the keyword recognition. Less than 90 were chosen, “Economics”, “Management”, “Neurosciences”, “Business”, “Behavioral Sciences”, and “Psychology” were some of them.

The path of the work is to create maps based on network data of comprehensive bibliometric analysis of research focused on eye-tracking metrics and packaging design across designated time periods. By utilizing bibliometric techniques, this thesis aims to map the evolution of research in the areas of eye-tracking technology and its application to packaging design, highlighting the most impactful studies and areas of concentrated scholarly interest.

In order to provide answers to the first research question, the publication trend in eye-tracking and packaging design is analysed by using data by year, author, journal, and country. All of the mentioned data is retrieved from Web Of Science Core Collection, based on the 889 search results from the platform. In the second research question the most cited and influential articles are discussed based on the results from Web of Science. The co-occurrence analysis of keywords is used in the third and fourth research question in order to analyse what intellectual structure and themes exist within the scientific field based on the keywords. Since this paper is written during the year of 2025, because of incomplete result numbers from this year they were not considered in the research. In order to answer the third and fourth questions and form clusters, VOSviewer and Web of Science platforms are used.

5.2 Results and Discussion

5.2.1 Current publication trends in the fields of eye metrics and packaging design

The publication trend in eye-tracking and packaging design is analysed by using data by year, author, journal, and country. The data by year is useful for identifying the peak periods of publication trends. The data by author is also useful because it provides data of which individuals are contributing and analysing the field the most. The data by journal is analysed in order to detect the key sources of publication, and whether they are from an academic background or for example from a blog-oriented background. The data by country is helpful in terms of detecting which countries are contributing to the field development the most in terms of publications.

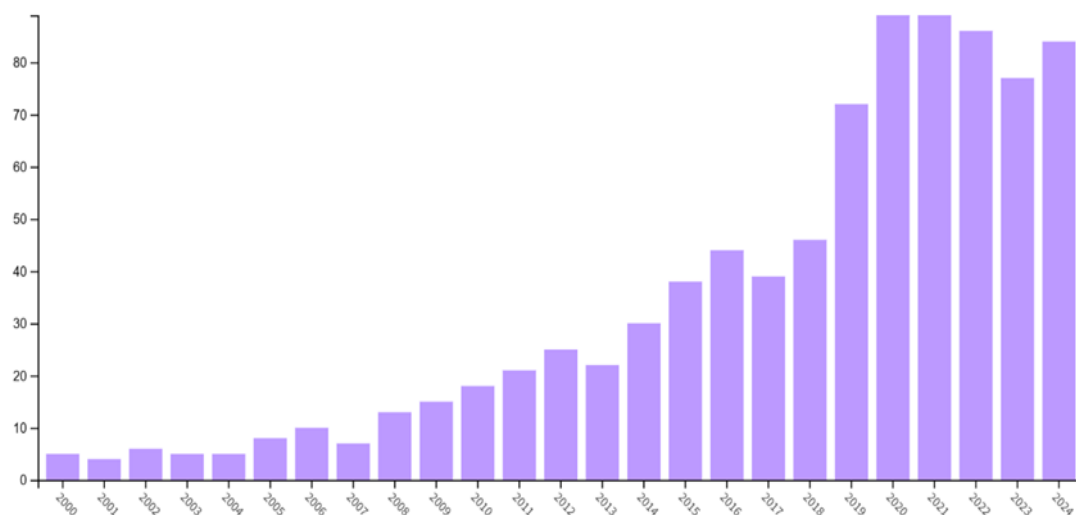
5.2.1.1 Publication trend by year

The publication trend by year is important in a bibliometric analysis because it helps to identify the development and growth patterns of research in a specific field over time.

Analysing yearly publication trends reveals how interest in a topic has evolved, highlights periods of rapid growth or decline, and helps forecast future research directions (Donthu et al., 2021). It also allows researchers to correlate peaks or drops in publication activity with external events, funding initiatives, or policy changes that may have influenced research output. The dataset of 889 publications from the Web of Science Core Collection covering the years 1994 to 2024 is showing a clear trend in academic interest in eye tracking and packaging design.

From 1994 to 2009, the yearly output remained low, with no more than 15 publications in any year. This can be interpreted as reflecting the limited availability of eye-tracking technology and probably a lack of integration between marketing, psychology, and design disciplines at the time. Starting in 2010, when the publication trend was 18, publication counts increased step by step. By 2018, the annual output reached 46, and in 2019 it climbed to 72. This growth continued, peaking in 2020 and 2021 with each year having 89 publications, the highest single-year counts, representing 20% of the dataset. Between 2019 and 2024, six consecutive years each exceeded 70 publications, which is indicating a period of sustained research activity, as well as global, and especially institutional engagement with the topic. The 2022, 2023, and 2024 years had a small decline of 86, 77, and 84 publications which is still much higher compared to the numbers before 2019. The amount of publications from 2019 to 2024 comprise 55% of the total dataset. The overall trend shows that research on eye tracking and packaging design grew steadily for over two decades, with the sharpest rise occurring after 2018 (see Figure 1). The reason for that is that the eye-tracking devices became more affordable and easier to use, enabling broader adoption in studies and research. The prices of devices were from \$100 and €100 (Rakhmatulin, 2020).

Figure 1: Number of publications in the fields of eye metrics and packaging design from 2000-2024 year based on data extracted from Web of Science (2025)



Source: Web of Science Core Collection 2025

The observed peak in publication trends related to eye-tracking and packaging design during the years 2020 and 2021 can be attributed to a combination of technological, methodological, and contextual factors that occurred during this period. First, the continued advancement and increased accessibility of eye-tracking technology enabled broader adoption across disciplines such as marketing, consumer psychology, and design (Wedel & Pieters, 2015). As the tools became more user-friendly and cost-effective, researchers were increasingly able to incorporate eye-tracking into empirical studies examining how consumers engage with product packaging, thereby contributing to a rise in scholarly output.

Second, the growing emphasis on data-driven and evidence-based design approaches in packaging further stimulated research interest. Eye-tracking provided objective metrics, such as fixation duration and gaze patterns, that could be linked to consumer attention, preference, and decision-making behaviour (Gidlöf et al., 2017). Those metrics made eye-tracking particularly appealing for academic and applied research during this period.

Third, while the COVID-19 pandemic in 2020 initially disrupted many areas of research, it also led to shifts in consumer behaviour and heightened interest in health-related packaging features, such as front-of-pack labels and nutritional information (Wulansari & Pongpimol, 2023). These changes likely inspired new research agendas exploring how consumers visually process such cues (Silayoi & Speece, 2007), leading to a rebound and subsequent peak in research outputs by late 2020 and throughout 2021.

Moreover, the pandemic prompted researchers to analyse digital packaging formats and simulate shelf environments remotely, which aligned well with the capabilities of eye-tracking in both in-lab and remote setups (Țichindelean et al., 2021). These adaptive strategies may have facilitated continued research output despite earlier logistical challenges. In summary, the peak in publications in 2020 and 2021 reflects both the maturation of eye-tracking as a research method in packaging and the influence of external conditions that intensified the focus of research on visual consumer behaviour during that period.

5.2.1.2 Publication trend by authors

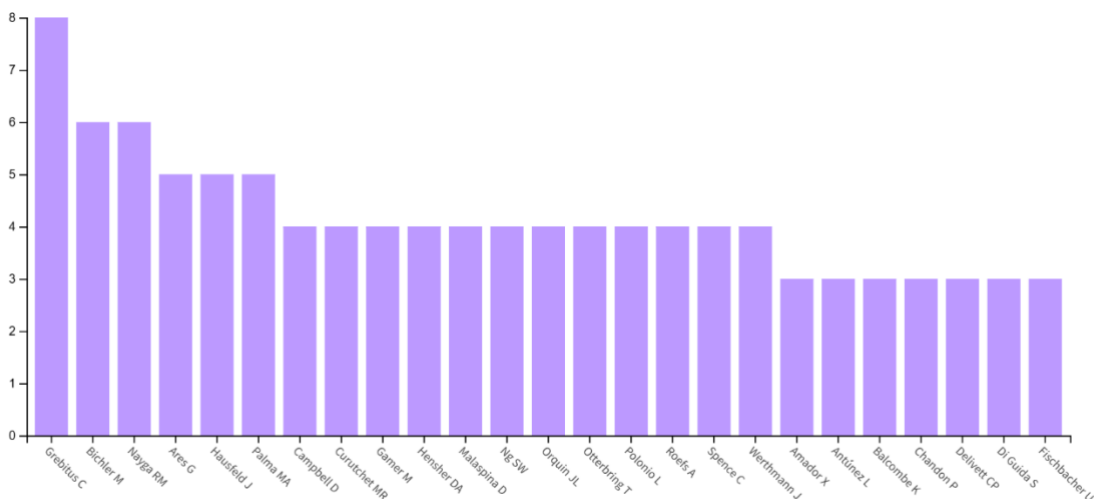
The analysis of publication trends by author is a crucial aspect of bibliometric analysis, as it helps identify the most prolific and influential contributors within a specific research domain. Evaluating author productivity over time provides insight into individual scholarly methods, the consistency of contributions, and the development of key thought leaders in the field (Donthu et al., 2021). This information is particularly valuable for understanding the maps of collaboration networks, and recognizing potential mentors, collaborators, or experts for peer review and editorial responsibilities.

Moreover, analysing author-level publication trends is useful for detecting shifts in research focus, interdisciplinary engagements, and patterns of scholarly dominance or diversification. It also supports the evaluation of scientific impact when paired with citation metrics, enabling a more nuanced understanding of both quantity and quality in scholarly output (Aria & Cuccurullo, 2017).

The authorship distribution of publications on eye tracking and packaging design reveals a relatively fragmented field, with only a few researchers contributing constantly. Among the 889 records analysed, the most prolific author is Grebitus with eight publications. Grebitus works are mostly focused on consumer food preferences and consumer attention

on brands (Van Loo et al., 2018; Lewis et al., 2016). Nayga and Brichler follow him with six publications, while Ares, Hausfeld, and Palma each contributed five. The research of Nayga had its focus on the use of eye tracking technology while designing packages (Van Loo et al., 2018; Lewis et al., 2016). The research papers of Ares were also about the use of eye-tracking for packaging design (Arrúa et al., 2017; Machin et al., 2023), while the papers of Hausfeld and Palma had eye-tracking as their main themes (Hausfeld et al., 2021; Segovia & Palma, 2021). A cluster of twelve authors, which include Campbell, Curutchet, Gamer, Hensher, Malaspina, Ng, Orquin, Otterbring, Polonio, Roefs, Spence, and Werthmann, each published four papers. A broader group of 23 authors contributed three publications each, reflecting a moderate engagement in this specific field of research (see Figure 2).

Figure 2: Number of publications by author on eye-tracking and packaging design from 1994-2024 based on data extracted from Web of Science (2025)



Source: Web of Science Core Collection 2025

The rest of the dataset consists of more than one hundred authors with two contributions each. This indicates a high level of decentralization and suggests that eye tracking in the context of packaging design is not dominated by a small core of experts, but rather characterized by diffuse and possibly interdisciplinary participation. The presence of authors such as Camerer and Orquin, which papers are focused on behavioural or economic research, brings to the assumption that this research area attracts scholars from

different domains, including neuroscience, consumer psychology, behavioural economics, and marketing.

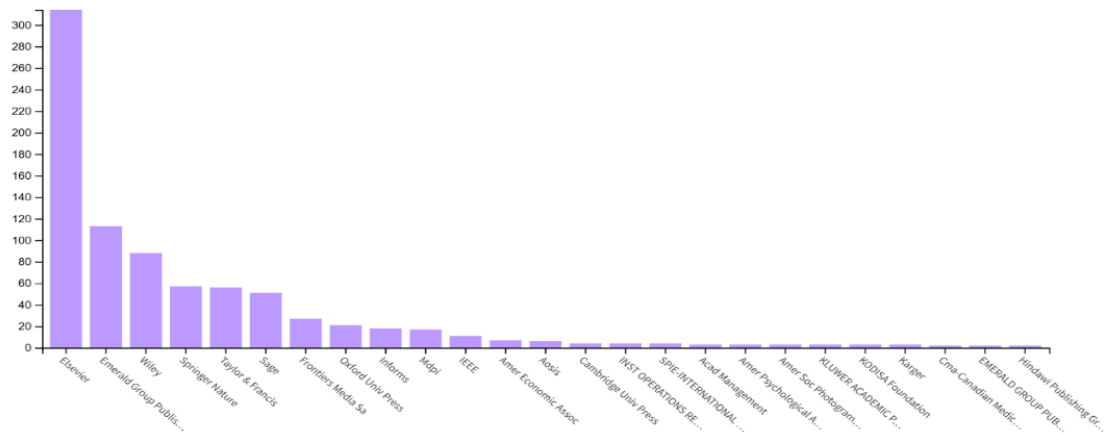
From a structural standpoint, this distribution has strengths and challenges. The diversity of contributors supports methodological pluralism and cross-disciplinary research, but it may hold back the results or the formation of a consistent theoretical structure. Future bibliometric mapping or co-authorship network analysis could clarify whether new clusters of expertise are being established or if the field will continue to operate in a more of a divided manner.

5.2.1.3 Publication trend of eye tracking and packaging design by publisher

Analysing the publication trend by publisher is an essential component of bibliometric analysis, as it helps to identify the key sources and dissemination channels through which research within a specific field is communicated. Publishers, particularly academic journals, play a critical role in shaping the visibility, credibility, and impact of scholarly work. By examining which publishers or journals consistently contribute to a field, researchers can determine where the intellectual discourse is concentrated and which outlets are considered authoritative by the academic community (Donthu et al., 2021).

Moreover, tracking the publication output of specific journals over time allows for the assessment of changes in editorial focus, thematic evolution, and the rise of new journals that may be capturing emerging research trends. It also informs decisions related to manuscript submission, journal selection for literature reviews, and the evaluation of disciplinary maturity and fragmentation (Aria & Cuccurullo, 2017). Understanding the role of publishers helps to uncover geographic or institutional publication biases, providing a more complete picture of the field's knowledge. The publication trend by publishers in the field of eye tracking and packaging design reveals a clear dominance of commercial academic publishers (see Figure 3).

Figure 3: Number of publications of eye tracking and packaging design by publisher from 1994-2024 based on data extracted from Web of Science (2025)



Source: Web of Science Core Collection 2025

Elsevier accounts for the largest share, with 314 publications representing 35% of the total output. This concentration indicates Elsevier’s important role in "spreading" research within this interdisciplinary domain, likely due to its broad portfolio across technology, marketing, and behavioural sciences. Emerald Group Publishing follows with a three times smaller share of 12%. The articles of this publisher are dominantly focused on the topic of packaging design. Wiley publisher has a slightly lower performance with 88 publications which make its level of presence at 10%. These three publishers collectively represent approximately 57% of the literature, suggesting a visible dominance in shaping access and visibility in this research area.

Smaller but notable contributions come from Springer Nature, Taylor & Francis, and Sage holding 6.4%, 6.2%, and 5.7% with 57, 56, and 51 publications. Their involvement highlights the inclusion of open access and more specialized outlets, reflecting a diversification of publication venues beyond the traditional large houses. Frontiers Media Sa and Oxford University Press contribute a bit less, at 3% and 2.3%, which points the level of participation from university presses and open access publishers catering to interdisciplinary topics.

The distribution further extends into niche academic and professional societies, including the American Psychological Association, INFORMS, IEEE, and the Cambridge

University Press, each accounting for less than 1.5% individually. These smaller shares can suggest that while the core research is housed within commercial publishers, there is still some engagement from discipline-specific or society-driven platforms that emphasize behavioural, psychological, or engineering perspectives.

From a strategic perspective, the dominance of a few large publishers may influence research patterns, access costs, and the visibility of research within the eye tracking and packaging design community. The concentration suggests that authors and institutions aiming to maximize impact should direct primarily through these dominant publishers. At the same time, the presence of emerging open access and society-based publishers offers alternative routes for knowledge diffusion, which may gain importance as open science policies continue to improve.

5.2.1.4 Publication trend by country

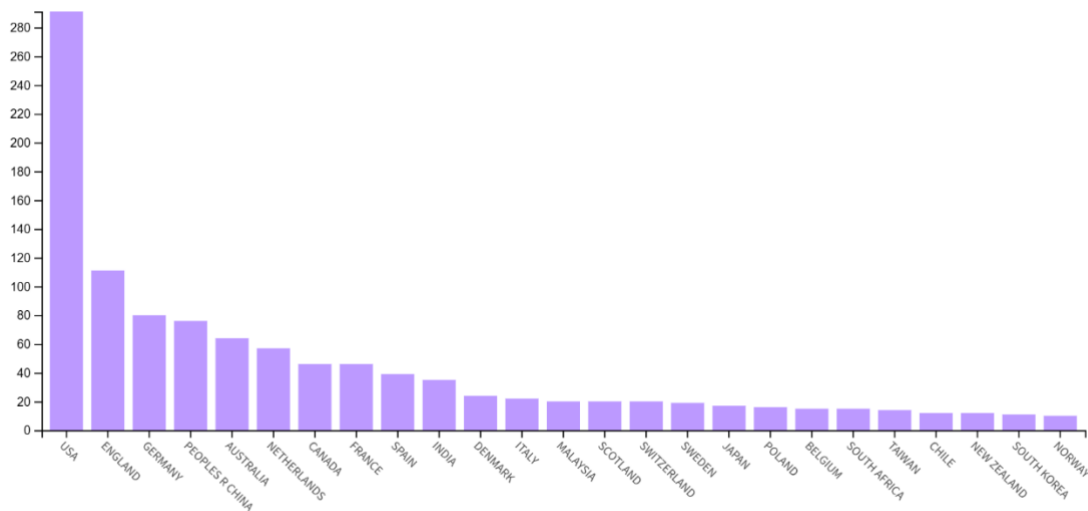
Analysing the publication trend by country is a critical dimension of bibliometric analysis, as it reveals the geographical distribution of scholarly output and offers insights into the global development of research within a specific field. By identifying which countries are the most active in producing scientific literature, researchers can assess the international landscape of academic contribution, determine national research strengths, and understand how global knowledge production is shaped by political, economic, and institutional factors (Donthu et al., 2021).

Publication trends by country also enable the evaluation of scientific collaboration networks, allowing for the identification of international partnerships and regional hubs of research excellence. Furthermore, such analysis helps to uncover disparities in research output, which may reflect unequal access to funding, infrastructure, or publication opportunities (Aria & Cuccurullo, 2017). Understanding these dynamics is essential for developing strategies aimed at promoting research equity and fostering global scientific collaboration.

Additionally, tracking country-level trends over time can illuminate the impact of national research policies, funding initiatives, or socio-economic events on academic productivity. For instance, a sudden increase in publications from a particular country may be indicative of strategic investments in higher education or research and development. The geographic distribution of publications related to eye tracking and packaging design exhibits a kind of

an "asymmetry", with a heavy concentration of scholarly output originating from more high-income, as well as research-intensive nations. The United States alone accounts for 32% of all records (291 out of 889), a figure that more than doubles the output of the next leading contributor, England at 12% with 111 publications (see Figure 4).

Figure 4: Number of publications by country from 1994-2024 based on data extracted from Web of Science (2025)



Source: Web of Science Core Collection 2025

This substantial lead can suggest not only deeper institutional investment in behavioural and consumer research but also a widespread access to costly biometric technologies, such as eye-tracking systems, which remain financially excessive for many institutions outside of the Global North. The top five contributors, which are the U.S., England, Germany (9%) with 80 publications, China (8.5%) with 76 publications, Australia (7%) with 64 publications, and Netherlands (6.5%) with 57 publications together produce more than 70% of the total research output. According to the numbers, we can say that this leading group of countries shapes the main body of knowledge and research standards in this field. In particular, the Netherlands' relatively high share, despite its smaller size, implies a concentrated research specialization likely driven by university-led consumer behaviour labs and public-private partnerships in design-focused industries. China's presence in this group stands out because of its increasing research activity and its growing focus on global retail and online shopping, both of which require advanced tools to understand consumer behaviour.

The middle tier of contributors, including Canada (5%), France (5%), Spain (4.3%), India (3.9%), and Denmark (2.7%), reflects broader interest in the application of eye tracking in design and marketing, but with fewer published outputs. These countries typically host leading universities and research institutions with active consumer research labs, but they may lack the same level of industrial demand or cross-sector integration seen in the United States or England. Further down the distribution curve, countries such as Italy, Malaysia, Scotland, Switzerland, Sweden, Japan, Poland, Belgium, and South Africa contribute between 1.5% and 2.5% of the total each. This group reflects moderate engagement, likely limited to a few academic centers or collaborative projects. Despite Japan's global technological advancements, their relatively low output in this specific domain suggests that eye tracking in packaging design may not be a core research priority or is embedded within broader usability or product design research streams.

Overall, the data reveals a visible hierarchy of research production, driven by economic capacity, institutional infrastructure, and industry-academia linkages. The concentration of publications in Western countries reflects disparities in resources and infrastructure, and likely influences the prevailing research models, methods, and contexts within the field. The minimal contribution from lower-income regions raises valid concerns about the extent to which findings can be applied globally, especially in diverse or developing markets. While wider participation may increase as biometric tools and academic publishing become more accessible, a larger expansion is unlikely without dedicated funding and structured international collaboration. Structural limitations are expected to persist in the absence of such support.

5.2.2 Most cited and influential articles that informed research on eye metrics and packaging design

The dataset shows a sharp divide between foundational cognitive science literature that uses eye metrics and more recent, application-focused research on consumer decision-making in packaging contexts. Although topic filters were made before forming the database in Web of Science platform, some articles appeared within results that do not fully align with the topic. They were excluded from the analysis and in the Table 1, most cited and influential articles were placed that exclusively belong to the thesis topic. At the top of the citation hierarchy is "Differences in attention to food and food intake between overweight/obese and normal-weight females under conditions of hunger and satiety" by Nijs et al. (2010), with a total of 365 citations and an average of 22.81 citations per year. While not focused on consumer packaging or product design, the article represents a

foundational methodological contribution that has benefited from more than a decade of citation growth. The steady citation count is partially attributable to its relevance across health and consumer domains rather than packaging-specific impact, and it serves more as a cornerstone of eye-movement research in eating behaviour than as a reference point for packaging studies.

Table 1: Most cited articles that informed research on eye metrics and packaging design based on data extracted from Web of Science (2025)

Title	Authors	Publication Year	Total Citations	Average per Year
Differences in attention to food and food intake between overweight/obese and normal-weight females under conditions of hunger and satiety	Nijs et al.	2010	365	22,81
Search Dynamics in Consumer Choice under Time Pressure: An Eye-Tracking Study	Reutskaja et al.	2011	346	23,07
The importance of packaging attributes: a conjoint analysis approach	Silayoi & Speece	2007	343	18,05
Front-of-pack nutrition labels. Their effect on attention and choices when consumers have varying goals and time constraints	van Herpen & van Trijp	2011	269	17,93
Multisensory Design: Reaching Out to Touch the Consumer	Spence & Gallace	2011	240	16
Keep Your Scanners Peeled: Gaze Behavior as a Measure of Automation Trust During Highly Automated Driving	Hergeth et al.	2016	223	22,3
How Package Design and Packaged-based Marketing Claims Lead to Overeating	Chandon	2013	170	13,08
The effects of nutrition package claims, nutrition facts panels, and motivation to process nutrition information on consumer product evaluations	Keller et al.	1997	153	5,28
Attention mediates the effect of nutrition label information on consumers' choice. Evidence from a choice experiment involving eye-tracking	Bialkova et al.	2014	142	11,83
Social Value Orientation and information search in social dilemmas: An eye-tracking analysis	Fiedler et al.	2013	133	10,23
Attentional Processing of Food Pictures in Individuals with Anorexia Nervosa-An Eye-Tracking Study	Giel et al.	2011	133	8,87

Impact of front-of-pack nutrition information and label design on children's choice of two snack foods: Comparison of warnings and the traffic-light system	Arrua et al.	2017	132	14,67
When Do Transparent Packages Increase (or Decrease) Food Consumption?	Deng & Srinivasan	2013	122	9,38
Do nutrition labels influence healthier food choices? Analysis of label viewing behaviour and subsequent food purchases in a labelling intervention trial	Mhurchu et al.	2018	112	14
Implications of accurate usage of nutrition facts panel information for food product evaluations and purchase intentions	Burton et al.	1999	107	3,96
Consumers' perceptions of food packaging: an exploratory investigation in Potchefstroom, South Africa	Venter et al.	2011	105	7
Package color saturation and food healthfulness perceptions	Mead & Richerson	2018	102	12,75

Source: Web of Science Core Collection 2025

In contrast, “Search Dynamics in Consumer Choice under Time Pressure: An Eye-Tracking Study” by Reutskaja et al. (2011) bridges behavioural economics and consumer psychology with 346 citations and an average of 23.07 per year. The third most cited article within this dataset is “The importance of packaging attributes: a conjoint analysis approach” by Silayoi and Speece from 2007, with its focus on packaging attributes and conjoint analysis. It has a total of 343 citations and which is 18.05 per year. The fourth most cited article in the dataset was focused on advanced statistical modelling.

The most cited article that actually discussed both packaging design and eye-tracking is “Front-of-pack nutrition labels. Their effect on attention and choices when consumers have varying goals and time constraints” by van Herpen and van Trijp from 2011. It was cited 269 times with an average rate per year of 17.93. It examines the attentional processes guiding nutrition-related choices, serving as an early precursor to packaging interaction research. Spence and Gallace (2011), in “Multisensory Design: Reaching Out to Touch the Consumer”, offer a directly relevant investigation of sensory integration in consumer environments. The article has accumulated 240 citations and maintains an average of 16 citations per year. This publication gives us the example of the application of multisensory cues in consumer scenarios and makes a methodological contribution to understanding packaging interactions in real-world settings. Its citation rate is particularly

impressive given its interdisciplinary authorship involving psychologists and marketing scientists.

A particularly notable paper for packaging research is Hergeth et al. (2016), “Keep Your Scanners Peeled: Gaze Behavior as a Measure of Automation Trust During Highly Automated Driving”, which has 223 citations and an average of 22.3 per year. Unlike broader cognitive research, this study is specifically anchored in applied eye-tracking literature and has had measurable influence on subsequent work on trust, gaze, and decision-making. The paper by Chandon (2013), “How Package Design and Packaged-based Marketing Claims Lead to Overeating”, has 170 citations, or about 13.08 annually. The interdisciplinary authorship, involving marketing scientists and behavioural researchers, contributes to its robustness and relevance. It also demonstrates the importance of the packaging design in the experimental consumer science.

5.2.3 Intellectual structure of current research on eye metrics and packaging design

Analysis of the intellectual structure will be performed with the help of the Web of Science and VOSViewer platforms. The dataset consisted of 889 documents from 1994-2024 from Web of Science were imported in the VOSViewer platform and keyword co-occurrence was performed. The co-occurrence analysis results provided 75 keywords divided into 5 clusters based on the co-occurrences between the keywords. It is important to note that the filter for keywords to be placed in the clusters is to have at least 12 occurrences. The number of links presents the number of other keywords with which a certain keyword has co-occurred at least once, or in the case of this paper 12 times. The total link strength presents the sum of all co-occurrences between a certain keyword and all other keywords that are linked with it. While the occurrences present the number of documents in which a keyword is used. Based on their co-occurrences, the themes were divided in five clusters that are presented in tables below. The first cluster of keywords identified through the co-occurrence analysis reveals a thematic structure centered on consumer behaviour, particularly in the context of food products and the information presented on their packaging. The cluster consists of 22 items, and in sum they have 745 occurrences, 918 links, and the total link strength of 2722. At the heart of this cluster is the relationship between consumers and the information they encounter when making food choices. Keywords such as "consumer," "consumers," "choice," "preferences," and "perception" point toward a strong interest in how individuals evaluate and select food products based on the cues available to them. These choices are shaped not only by individual preferences but also by how product information is perceived and understood.

Table 2: Cluster 1 of keywords (themes) in bibliometric research, based on data extracted from Web of Science (2025) and visualized using VOSviewer.

Item	Links	Total Link Strength	Occurrences
Cluster 1	918	2722	745
Choice	55	208	55
Claims	33	80	18
Consumer	32	58	15
Consumers	41	121	31
Consumption	43	129	31
Design	55	189	87
Food	50	168	44
Health Claims	35	76	17
Impact	59	259	73
Information	62	335	91
Labels	40	98	19
Memory	36	55	15
Nutrition	32	67	18
Nutrition Information	40	141	29
Packaging	33	80	24
Perception	47	134	38
Perceptions	44	105	28
Preferences	49	154	44
Product	32	60	16
Products	31	59	18
Quality	34	64	17
Search	35	82	17

Source: VOSViewer (2025)

A significant component of the cluster involves health-related communication, as indicated by terms like "health claims," "nutrition," "nutrition information," and "labels." This suggests that the way health and nutritional information is conveyed on a packaging plays a critical role in influencing consumer decisions. The presence of the keyword "information" further reinforces this focus on the communication process, highlighting the importance of clarity, trust, and credibility in how nutritional and health-related content is delivered. This points to a broader concern with how effectively such information supports informed and health-conscious consumption decisions.

Design and packaging are also central to the cluster, as evidenced by the inclusion of "design," "packaging," "product," and "products." These terms suggest an interest in the physical and visual aspects of food items, particularly how the design of packaging can affect consumer perceptions of quality, value, and healthfulness. Packaging serves not only as a container but also as a marketing tool and a communication medium, and its influence on purchasing behaviour is closely tied to visual design and the strategic presentation of claims and information.

Cognitive elements are reflected in keywords such as "memory," "impact," and "search," indicating that the processing of information is not purely rational but also involves psychological and behavioural dimensions. These terms imply that consumers do not simply read and interpret information, they also remember, seek, and are influenced by how that information is presented and accessed. This supports the notion that food choice is not only an economic or nutritional decision but also a cognitive one, shaped by how individuals mentally organize and retrieve product-related knowledge.

The keywords "food" and "consumption" connect these themes to actual behaviour, emphasizing the outcome of the information-processing and decision-making sequence. They highlight the end point of consumer interaction with food packaging: the act of consumption itself. This indicates that the research is likely to address not just how consumers think or feel about products, but also how these attitudes and perceptions translate into actual eating or purchasing behaviour.

Taken together, the cluster suggests a multidimensional approach to understanding food choice, drawing from consumer psychology, nutrition communication, packaging design, and behavioural science. It presents a research landscape in which consumer decisions are influenced by a complex interplay of product presentation, informational clarity, cognitive processing, and personal preference. This combination provides a rich foundation for exploring how design and communication strategies can be optimized to guide healthier and more informed food choices.

The second cluster of keywords from the co-occurrence analysis indicates a strong focus on the intersection of developmental neuroscience, cognitive psychology, and neuroimaging, particularly as they relate to visual attention and eye movement behaviour. The cluster has 16 items with the occurrence number of 401, links number of 449, and total link strength of 1062. The presence of terms like "children" and "adolescents"

suggests a developmental perspective, pointing toward research that examines how visual attention and cognitive processes evolve during early life stages. These keywords imply a population focus on younger individuals, possibly in both typical and atypical developmental trajectories.

Table 3: Cluster 2 of keywords (themes) in bibliometric research, based on data extracted from Web of Science (2025) and visualized using VOSviewer.

Item	Links	Total Link Strength	Occurrences
Cluster 2	449	1062	401
Adolescents	31	49	14
Attention	61	265	79
Brain	19	27	16
Children	36	68	23
Eye Movements	17	32	15
Eye Tracking	63	239	84
Eye-Movements	34	51	15
Individual-Differences	29	38	12
Metaanalysis	30	46	15
Movements	36	88	25
MRI	10	16	16
Responses	25	37	14
Schizophrenia	16	36	32
Segmentation	4	11	14
System	11	13	12
Tracking	27	46	15

Source: VOSViewer (2025)

The core methodological and behavioural focus of the cluster revolves around "eye movements," "eye tracking," and "tracking," which are repeated in multiple formats. These terms clearly emphasize the use of eye-tracking technology as a central tool for measuring visual attention and cognitive processing. This technique allows researchers to quantify how individuals allocate attention in visual tasks, which is further supported by the inclusion of "attention" and "responses" in the cluster. Together, these terms highlight a research framework centered on studying how individuals process visual stimuli, how their gaze patterns reveal underlying cognitive functions, and how this varies across different individuals or populations.

Further depth is added by the keywords "brain," "MRI," and "system," pointing to a likely integration of eye-tracking data with neuroimaging methods such as functional or structural MRI. This combination allows for a more complete investigation into the neural underpinnings of attention and visual behaviour. The term "segmentation" could relate either to image processing in brain imaging data or to parsing eye-tracking data into interpretable units, both of which are crucial for analysis in such multidisciplinary studies.

"Metaanalysis" suggests that some of the research in this area may synthesize findings across multiple studies to identify broader patterns or to validate the consistency of eye movement and brain response data across different samples or methodologies. The presence of this keyword highlights an evidence-based approach, likely with attention to robustness, generalizability, and cross-study comparison.

Altogether, this keyword cluster outlines a multidisciplinary research area that integrates cognitive and developmental psychology, eye-tracking technology, and neuroimaging to explore visual attention and brain function. It suggests a focus on both normative developmental processes in children and adolescents, as well as atypical trajectories in clinical populations like schizophrenia. The analysis of individual differences and the use of advanced tracking and imaging technologies position this research at the intersection of experimental psychology, neuroscience, and data-driven analysis. This cluster is well-suited for a thesis examining how attentional mechanisms develop or differ among individuals, and how tools like eye-tracking and MRI can reveal these cognitive and neural processes.

The third cluster of keywords extracted from the co-occurrence analysis centers on the dynamics of organizational behaviour, performance, and decision-making, particularly in the context of compensation structures, innovation management, and corporate governance. This cluster is consisted of 14 items. The items combined occurred in 305 papers, they had 338 links and 703 total link strength. The presence of terms such as "executive-compensation," "incentives," and "compensation" highlights a strong thematic focus on how financial and non-financial rewards influence managerial actions and strategic outcomes. These keywords suggest that the thesis work is situated within the broader field of corporate management and economics, with a specific interest in the mechanisms that drive executive behaviour and company performance.

Table 4: Cluster 3 of keywords (themes) in bibliometric research, based on data extracted from Web of Science (2025) and visualized using VOSviewer.

Item	Links	Total Link Strength	Occurrences
Cluster 3	338	703	305
Auctions	7	8	13
Behaviour	61	155	53
Compensation	16	28	14
Corporate Governance	10	27	14
Determinants	28	42	16
Executive-Compensation	11	24	12
Incentives	14	30	13
Innovation	16	24	13
Knowledge	32	49	13
Management	19	44	29
Motivation	33	67	13
Performance	44	124	68
Risk	26	53	22
Science	21	28	12

Source: VOSViewer (2025)

The term "corporate governance" signals a structural and regulatory dimension to the discussion, indicating that the study may also explore how oversight mechanisms, board structures, and governance frameworks shape or are shaped by compensation policies. When considered alongside "executive-compensation" and "risk," this suggests an investigation into how compensation packages are designed not only to incentivize high performance but also to manage risk-taking behaviour among top executives.

"Behaviour," "motivation," and "performance" introduce psychological and behavioural economics perspectives into the discussion, implying that the thesis could draw on theories of motivation and decision-making to understand the link between incentives and outcomes. These concepts are central to assessing whether compensation systems actually lead to improved organizational performance or whether they produce unintended consequences such as excessive risk-taking or short-termism.

"Innovation" and "knowledge" suggest that the thesis may also examine outcomes beyond financial metrics. Innovation is often linked to intrinsic motivation and long-term strategic thinking, while knowledge signals a possible interest in knowledge management or

intellectual capital. This could point to a broader definition of performance, where success is not only about profitability but also about fostering an innovative and adaptive organizational culture.

"Determinants" and "management" indicate an analytical lens focused on identifying the underlying variables or conditions that influence compensation design and organizational outcomes. This reflects a hypothesis-driven approach, where different organizational, individual, or market-level factors are studied to explain variations in behaviour and performance.

The keyword "auctions" introduces a more specialized and perhaps methodological element. It may suggest the use of auction theory or auction-based mechanisms as part of the study design, perhaps in the context of experimental economics or as a metaphor for competitive resource allocation within organizations. Alternatively, it could point to empirical settings where auction data is used to analyse managerial behaviour under different incentive conditions.

Finally, the presence of "science" indicates that the research aspires to a systematic, evidence-based approach, possibly integrating quantitative modeling, statistical analysis, or structured literature review methods. The combination of theory-driven exploration and empirical validation reflects a scientific orientation that aims to contribute to both academic understanding and practical application in the fields of business management, corporate governance, and behavioural economics.

Taken together, this keyword cluster suggests a thesis that investigates how executive incentives and compensation systems influence managerial behaviour and organizational performance, with additional attention to governance structures, innovation outcomes, and risk management. The research likely draws from a multidisciplinary foundation, integrating economics, management theory, and behavioural science to provide insights into how organizations can better align their incentive structures with strategic objectives. The fourth cluster consisted of 12 keywords from the co-occurrence analysis that reveals a thematic connection centred around the application of eye-tracking technology in understanding food-related decision-making processes, particularly in relation to health outcomes such as obesity and overweight. Those 12 keywords occurred 327 times and were linked with 460 keywords. The total number of the keywords being used with other keywords is 1287. This is highly relevant to a thesis focused on bibliometric analysis of the

use of eye-tracking in packaging design, as it highlights how visual stimuli on food packaging influence consumer behaviour and attention mechanisms.

Table 5: Cluster 4 of keywords (themes) in bibliometric research, based on data extracted from Web of Science (2025) and visualized using VOSviewer.

Item	Links	Total Link Strength	Occurrences
Cluster 4	460	1287	327
Attention Bias	23	47	15
Bias	40	73	16
Cues	44	111	26
Eating Behaviour	27	52	12
Eye-Tracking	63	381	112
Food Choice	40	82	14
Health	35	71	17
Obesity	50	132	38
Overweight	28	51	13
Stimuli	25	57	18
Visual Attention	36	70	17
Visual-Attention	49	160	29

Source: VOSViewer (2025)

Keywords such as "eye-tracking," "visual attention," and "visual-attention" indicate that the literature frequently employs eye-tracking methodologies to study how individuals engage with visual cues in food environments. These methods provide insight into what draws consumer attention and how long it is held, which is critical in packaging design research. The repetition of terms related to attention, including "attention bias" and "bias," suggests that there is a specific interest in how consumers may be subconsciously drawn to certain types of packaging or product features, potentially leading to biased decision-making processes that influence food choices. The presence of terms like "cues," "stimuli," and "eating behaviour" further emphasizes the experimental nature of much of this research. These studies often use visual stimuli in controlled settings to observe how different packaging elements such as images, colors, or health labels act as cues that affect eating behaviour and decision-making. This connects directly to the role of packaging design in guiding consumer choices, whether toward healthier or less healthy food options.

Keywords such as "food choice," "health," "obesity," and "overweight" link visual attention and packaging directly to public health concerns. This implies that a significant

body of research investigates how packaging can either contribute to or mitigate unhealthy eating patterns, particularly in populations at risk for obesity. Eye-tracking is thus used not only as a tool for marketing optimization but also as a way to understand the psychological and perceptual mechanisms that contribute to health-related behaviour. The fifth cluster, with its 11 items, indicates that the use of eye-tracking in packaging design goes beyond mere consumer preference analysis and touches on deeper cognitive and behavioural patterns. The sum of occurrences of the cluster is 241, while the sum of links and total link strengths are 335 and 814. It shows that visual attention is not uniformly distributed and can be influenced by individual differences, including predispositions toward certain types of food, which may explain observed variations in food choices and health outcomes. Packaging design, therefore, becomes a critical interface between marketing and public health, capable of directing visual attention in ways that can promote or hinder healthy behaviour.

Table 6. Cluster 5 of keywords (themes) in bibliometric research, based on data extracted from Web of Science (2025) and visualized using VOSviewer.

Item	Links	Total Link Strength	Occurrences
Cluster 5	335	814	241
Age	20	32	15
Attitudes	36	71	14
Attribute Non-Attendance	28	95	16
Brand	36	70	15
Decision-Making	44	114	29
Demand	25	31	13
Discrete Choice Experiment	22	44	12
Model	42	138	60
Models	22	39	20
Simulation	22	23	12
Willingness-to-Pay	38	157	35

Source: VOSViewer (2025)

Overall, the cluster reflects a multidisciplinary research area where psychology, health science, marketing, and design converge. For a master thesis focused on bibliometric analysis, this cluster highlights an important thematic axis within the literature: the use of eye-tracking to examine how visual design in food packaging affects attention, biases, and ultimately consumer health outcomes. It points to an evolving research interest in using eye-tracking not only to enhance product appeal but also to design interventions that

support healthier eating behaviours through visual and cognitive engagement with packaging.

This cluster of keywords is connected by a focus on modelling consumer decision-making processes, particularly in the context of how individuals evaluate packaging elements and make trade-offs when selecting products. Within the scope of a thesis on bibliometric analysis of the use of eye tracking in packaging design, these terms point toward a body of literature that integrates behavioural economics, marketing science, and experimental methods to understand how visual attention and consumer preferences interact during choice scenarios.

The keyword "discrete choice experiment" is central to this cluster, as it represents a widely used methodological framework in packaging research to quantify how different product attributes, such as brand, price, nutritional content, or visual design, contribute to consumer preferences. Discrete choice experiments are often paired with eye-tracking tools to link stated preferences with actual visual behaviour, providing more robust insights into how attention allocation influences choice. This link is especially relevant when considering "attribute non-attendance," a term that describes situations where consumers ignore certain product attributes during the decision-making process. Eye-tracking can be used to validate whether non-attendance is a cognitive choice or simply a failure to visually process certain elements.

The inclusion of "decision-making," "attitudes," and "willingness-to-pay" reflects the psychological and economic dimensions of consumer behaviour studies. These keywords suggest that the research often aims to uncover not just which packaging features are noticed, but also how they shape underlying attitudes and translate into economic behaviour such as purchasing willingness. Eye-tracking adds value to this analysis by revealing subconscious attention patterns that traditional survey methods may miss, providing a more nuanced understanding of how packaging design affects perceived product value.

Keywords such as "brand" and "demand" emphasize market-oriented perspectives. Brand recognition and loyalty can heavily influence visual attention, and demand models often incorporate brand effects when simulating market scenarios. "Simulation" and "models" indicate that much of the research in this cluster is predictive, aiming to forecast consumer behaviour under different design or market conditions. This aligns with the growing use of

eye-tracking data in simulation-based modelling to refine package design before full-scale implementation.

The presence of "age" suggests that demographic factors are considered in these models, acknowledging that attention patterns and decision strategies may vary across age groups. Age can influence both cognitive processing and visual preferences, which are critical factors when designing packaging that resonates with different consumer segments.

This keyword cluster reflects a quantitative and decision-focused strand of research within the broader domain of eye-tracking and packaging design. It shows that researchers are not only interested in what consumers look at but also in how those visual engagements translate into structured economic choices. For a bibliometric thesis, this cluster highlights a substantial subfield that bridges eye-tracking with choice modelling to better understand and predict consumer responses to packaging elements in both experimental and real-world contexts.

5.2.4 Themes existing in the field of eye metrics and packaging design and how they relate with each other

In order to better understand the themes that are existing within the topic and its 889 documents included in the database, co-occurrence analysis was performed. The co-occurrence and keyword analysis are being performed to determine which keywords are presenting the contents of papers (Comerio & Strozzi, 2019). In order to find this out, Web of Science results were imported and obtained in the VOSViewer platform. The keyword dataset provided by the VOSViewer platform consisted of 75 items including only keywords that occurred at least 12 times. The metrics to measure which keywords mostly occurred, and by that which themes mostly exist, are the number of links, total link strengths, and occurrences.

The clusters of keywords (themes) that co-occurred together will be discussed. The clusters are already presented in tables 2-6. The key keywords (themes) from those clusters will be analysed here in order to provide the answer to the research question. The metrics to measure which keywords mostly occurred, and by that which themes mostly exist, are the number of links, total link strengths, and occurrences.

present a strong theme, but the links occurred less times compared to the “Eye-Tracking” keyword. The “Information” keyword from the cluster 1 (see Table 2) is the second best ranked in terms of occurrence since it occurred in 91 papers, and its existence in many papers is understandable since the perception of humans based on the packaging design is described in most papers as “Information”. In terms of links it is the third best ranked item since it was linked 62 times, while in terms of the total link strength it is ranked as the second best item with the strength of 335.

The reason why eye-tracking is presented weaker than it is because in many works it is used as “eye tracking” which is recognized differently by the platforms Web of Science and VOSViewer. The “Eye Tracking” keyword from cluster 2 (see Table 3) has 84 occurrences, 63 links and 239 total link strength. It shares the first place in terms of links with “Eye-Tracking”. It is also fifth best ranked in terms of total link strength and fourth best ranked in terms of occurrence. These numbers are even more presenting the general term of eye-tracking as the most used theme in the research papers. The fifth best ranked item in terms of occurrence is “Attention” from cluster 2 with its presence in 79 different papers. In terms of links, it is the fourth best ranked while being linked with other 61 keywords, while its total link strength is 265 which is the third best result. The keyword “Impact” from cluster 2 (see Table 3) is also important to mention since it occurred in 73 different papers and is linked to 59 other keywords, while its total link strength is 259. In terms of occurrence and links it is the sixth best ranked keyword, while in terms of its total link strength it is fourth best ranked.

The most mentioned clusters in the analysis above are cluster 1 and 2, while the strongest keyword is from cluster 4. Before the analysis of cluster structures it is important to mention the top keywords from clusters that were not mentioned and those are cluster 3 (see Table 4) and cluster 5 (see Table 6). The strongest keywords from cluster 3 are “Performance” and “Behaviour”. “Performance” occurred in 68 different papers and it is seventh best ranked in terms of occurrence, while “Behaviour” occurred in 53 different papers and it is the tenth most occurred paper from the dataset. The number of links of the “Behaviour” keyword is 61 which makes it the fifth most linked keyword to other keywords, while its total link strength is 155 which puts it to the eleventh place by the link strength. “Performance” keyword was linked to other keywords 44 times and has a total linked strength of 124. These results do not place the keyword as top 10 performers in terms of links and total link strength.

The keyword “Model” from cluster 5 (see Table 6) was used in 60 different papers which means it is the eighth most occurred keyword from the dataset. A model describes how colors, typography, and shelf positions affect visual intention and consumer behaviour. The keyword has links with 42 other keywords and those links occurred 138 eight times. This leads to the conclusion that the best performance of the keyword is in terms of occurrence. “Willingness-to-Pay” from cluster 5 is the tenth best performer in terms of total link strength. It was used with other keywords for 157 times, while the number of keywords with which it was linked is 38 and the number of times it occurred in some research papers was 35.

6 CONCLUSION

This thesis examined the intersection of eye-tracking research and packaging design through a comprehensive bibliometric analysis of publications indexed in the Web of Science Core Collection from 1994 to 2024. The findings demonstrate a steady but modest growth in research output until 2010, followed by a significant acceleration from 2018 onward, culminating in peaks during 2020 and 2021. This surge can be attributed to the increasing affordability and accessibility of eye-tracking technologies, the expansion of data-driven approaches to consumer research, and the contextual influence of shifting consumer behaviors during the COVID-19 pandemic.

The author-level analysis revealed a fragmented authorship structure, with only a small number of prolific researchers and a wide distribution of occasional contributors. This fragmentation underscores the interdisciplinary nature of the field, which draws on marketing, psychology, neuroscience, and behavioral economics. Similarly, the analysis of publishers showed a concentration of output within a few large commercial publishing houses, led by Elsevier, while also highlighting the growing role of open access outlets. The country-level distribution confirmed a strong dominance of research from the United States, England, Germany, China, and the Netherlands, reflecting disparities in access to research infrastructure and industry–academia integration.

Citation analysis identified a dual foundation: highly cited methodological works from consumer psychology and behavioural economics, and more recent applied studies that directly engage with packaging design, nutrition data, and consumer decision-making. Particularly influential were studies addressing nutrition labeling, visual attention in food choice, and packaging’s role in consumer perceptions, demonstrating how eye-tracking

contributes to practical and policy-relevant insights. The thematic mapping through keyword co-occurrence confirmed the centrality of “eye-tracking” and “design” as dominant themes, linked closely with concepts such as “information,” “attention,” and “impact.” These clusters illustrate the field’s focus on visual attention mechanisms, consumer responses to packaging cues, and the implications for health communication and product differentiation. Importantly, the analysis highlights both the opportunities of applying eye-tracking as an objective measure of consumer attention and the challenges of balancing methodological rigor with interdisciplinary fragmentation.

In conclusion, the bibliometric evidence indicates that research on eye-tracking and packaging design has matured into a robust and rapidly evolving field, marked by technological progress and increasing relevance to consumer research. However, its development remains uneven across regions and fragmented across disciplinary boundaries. Future progress will likely depend on stronger international collaboration, greater integration of methodological frameworks, and the application of findings to diverse cultural and market contexts. Beyond its academic contribution, this study also underscores the managerial relevance of eye-tracking for understanding consumer decision-making, guiding packaging innovation, and informing regulatory discussions on labeling and communication. For practitioners, insights from this field provide tools to optimize package elements such as design, color, labeling, and branding to better capture attention and influence purchase behavior. For policymakers, evidence from eye-tracking studies can inform public health campaigns and labeling standards, ensuring that communication strategies are both effective and transparent. On the theoretical side, the findings highlight the potential of eye-tracking to connect consumer psychology and marketing by offering measurable indicators of attention and preference formation. By clarifying the publication trends, influential works, and thematic structures, this study provides a foundation for more targeted, theoretically grounded, and collaborative research in the years ahead, with direct implications for both scholarship and practice.

Nevertheless, this thesis is not without limitations. The reliance on the Web of Science Core Collection means that relevant studies indexed in other databases or published in non-English outlets may have been excluded, potentially underrepresenting contributions from certain regions. In addition, bibliometric methods, while powerful for mapping large-scale trends, cannot fully capture the qualitative depth of research designs, theoretical frameworks, or contextual influences that shape the field. Future research could address these limitations by incorporating multiple databases, expanding the scope to include conference proceedings and practitioner-oriented publications, and combining bibliometric

approaches with systematic reviews or meta-analyses. Longitudinal and cross-cultural studies that integrate eye-tracking with complementary methods such as interviews, experiments, or physiological measures would further enrich the understanding of how packaging design influences consumer attention and behavior across diverse settings.

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