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The effect of the images depicted on food packaging on consumer perception and response

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Ignacio Gil Pérez

2018 PhD thesis

supervisors
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PhD Thesis

The effect of the images depicted on food packaging on consumer perception and response

Análisis de la influencia de la imagen mostrada en los envases alimentarios en la percepción y expectativas del consumidor

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Dr. Iván Lidón López

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A María
y su sonrisa.

The body of this thesis consists in a compilation of **six manuscripts**, of which **five have been published in international JCR scientific journals** of the **Food Science and Technology** category and one has been submitted for publication:

- Rebollar, R., **Gil, I.**, Lidón, I., Martín, J., Fernández, M. J., & Rivera, S. (2017). How material, visual and verbal cues on packaging influence consumer expectations and willingness to buy: The case of crisps (potato chips) in Spain. *Food Research International*, *99*, 239–246. https://doi.org/10.1016/j.foodres.2017.05.024

- Rebollar, R., Lidón, I., **Gil-Pérez, I.**, & Martín, J. (2018). Images used to convey that a natural yogurt is sweetened influence consumer expectations and willingness to buy. *Submitted to the Journal of Dairy Science*.

- Rebollar, R., Lidón, I., **Gil, I.**, Martín, J., Fernández, M. J., & Riveres, C. E. (2016). The influence the serving suggestion displayed on soft cheese packaging has on consumer expectations and willingness to buy. *Food Quality and Preference*, *52*, 188–194. https://doi.org/10.1016/j.foodqual.2016.04.015

- Lidón, I., Rebollar, R., **Gil-Pérez, I.**, Martín, J., & Vicente-Villardón, J. L. (in press). The influence the image of the product shown on food packaging labels has on product perception during tasting: Effects and gender differences. *Packaging Technology and Science*. https://doi.org/10.1002/pts.2407

- **Gil-Pérez, I.**, Rebollar, R., Lidón, I., Piqueras-Fiszman, B., & van Trijp, H. C. M. (2019). What do you mean by hot? Assessing the associations raised by the visual depiction of an image of fire on food packaging. *Food Quality and Preference*, *71*, 384–394. https://doi.org/10.1016/j.foodqual.2018.08.015

- **Gil-Pérez, I.**, Rebollar, R., Lidón, I., Martín, J., van Trijp, H. C. M., & Piqueras-Fiszman, B. (2019). Hot or not? Conveying sensory information on food packaging through the spiciness-shape correspondence. *Food Quality and Preference*, *71*, 197–208. https://doi.org/10.1016/j.foodqual.2018.07.009

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Abstract

Food shopping is a low-involvement process in which consumers spend little time and cognitive resources evaluating products and deciding which to choose. Literature shows that people unconsciously rely on heuristics to make judgements and use the different packaging cues as diagnostic tools by which they infer product attributes and information; thus, each packaging cue should be designed considering what its role will be in this process. Although a great deal of research studies how the different packaging cues convey meaning and thereby affect perception, the role of packaging imagery has barely been studied, despite being a prominent visual sign that draws attention at the point of sale and requires a type of unconscious and unintentional processing. Specifically, the influence of some image's features such as its subject (i.e. what is depicted on it) on consumer perception and response is still almost unexplored. Moreover, images tend to be intrinsically ambiguous stimuli since they can elicit different interpretations (e.g. depicting fire on a bag of nuts can convey either roast flavour or spiciness). Thus, for designers, it is not easy to foresee how an image will be interpreted, since the underlying mechanisms of this process have only attracted modest scientific attention to date.

Therefore, the aim of this thesis is twofold. First, it seeks to study how manipulating the subject shown on packaging imagery influences consumer expectations, perception, and response towards the product. Second, it aims to investigate how consumers infer meaning from ambiguous images. These objectives are addressed across six research studies by using an array of methods and techniques such as questionnaires, self-report scales, projective techniques, and speeded classification tasks. The results show that both manipulating what is depicted on the image and the way it is depicted influence consumer expectations and response, since the attributes of the products displayed on the packaging tend to influence the evaluation of the product contained within (although

the effect is stronger for expectations than for perception during tasting). In addition, the work compiled here demonstrates that the congruence between the image's possible meanings and the product's potential attributes plays a key role in how the image is interpreted, since the more congruent meaning tends to be favoured. Moreover, the results also show that the interpretation given to an image can be modulated by manipulating the image's shape. Overall, these findings contribute to research on design, semiotics, sensory science, and consumer psychology, and thus are discussed under an interdisciplinary approach.

This thesis has been carried out following the official procedure for the completion of an International PhD, for which the candidate did a three-month research stay at the Wageningen University Marketing and Consumer Behaviour group (in The Netherlands). The main body of this dissertation consists of a **compilation of six manuscripts**, of which five have been published in international JCR scientific journals of the Food Science and Technology category, and one has been submitted for publication.

Resumen

Comprar comida es un proceso de baja implicación en el que los consumidores invierten poco tiempo y recursos cognitivos decidiendo qué comprar. La literatura muestra que la gente se apoya inconscientemente en juicios heurísticos y usa los diferentes elementos del envase como herramientas diagnósticas en base a las que inferir atributos e información del producto, por lo que cada elemento del envase debe diseñarse considerando cuál será su papel en este proceso. Aunque un gran número de investigaciones estudia el modo mediante el que los distintos elementos del envase comunican información (y por lo tanto afectan a la percepción), el papel específico de las imágenes en este proceso ha sido escasamente estudiado a pesar de ser un importante elemento visual que atrae la atención en el punto de venta y requiere un tipo de procesado inconsciente y no intencional. Específicamente, tan apenas sabemos nada respecto a la influencia que tienen algunas características de la imagen, como su motivo (es decir, qué se muestra), en la percepción y respuesta del consumidor. Además, las imágenes tienden a ser estímulos intrínsecamente ambiguos que pueden evocar distintos significados (por ejemplo, en un paquete de frutos secos, una imagen de fuego puede interpretarse como que los frutos secos son tostados o que son picantes). Por ello, para los diseñadores no es fácil anticipar cómo interpretarán los consumidores una imagen ya que los mecanismos subyacentes a este proceso han sido hasta la fecha poco estudiados.

Esta tesis tiene por tanto un doble objetivo. Primero, busca estudiar cómo la manipulación del motivo mostrado en las imágenes de un envase influye en las expectativas, percepción y respuesta del consumidor. Segundo, pretende investigar el proceso mediante el que los consumidores infieren significado a partir de imágenes ambiguas. Estos objetivos se abordan a través de seis estudios de investigación utilizando un conjunto de técnicas y métodos tales como cuestionarios, escalas de auto-evaluación, técnicas proyectivas y prue-

bas de clasificación rápida. Los resultados muestran que tanto manipular qué se muestra en una imagen como cómo se muestra influye en la percepción y respuesta del consumidor, puesto que los atributos de aquello representado en el envase tienden a influir en la evaluación del producto contenido en su interior (aunque el efecto es mayor en las expectativas que en la percepción en cata). Además, el trabajo reunido aquí demuestra que la congruencia entre los posibles significados de la imagen y los atributos potenciales del producto juega un papel crucial en el modo en que la imagen es interpretada (puesto que tiende a favorecerse los significados más congruentes), y que la interpretación dada a una imagen puede modularse mediante la manipulación de su forma. En general, estos resultados contribuyen a los campos del diseño, la semiótica, la ciencia sensorial y la psicología del consumidor y por lo tanto se discuten desde un enfoque interdisciplinar.

Esta tesis se ha desarrollado siguiendo el procedimiento oficial para conseguir un doctorado internacional, para lo que el doctorando realizó una estancia de investigación de tres meses en el Marketing and Consumer Behaviour group de la Universidad de Wageningen (Países Bajos). El cuerpo principal de esta tesis consiste en una **compilación de seis artículos**, de los que cinco han sido publicados en revistas científicas indexadas en la categoría Food Science and Technology del JCR y uno se encuentra en revisión.

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1. INTRODUCTION

1.1. Starting point

Almost every marketed product comes in some form of packaging. This is true not only throughout the different phases of the supply chain but also at the point of sale, where it is difficult to find a single product which is marketed completely unpackaged (Azzi, Battini, Persona, & Sgarbossa, 2012). As a visit to any supermarket shows, packaging has become a common part of the consumption process (Mumani & Stone, 2018). However, the importance of packaging within this process has been gaining traction over the years, since today its role goes far beyond the mainly functional role that it was supposed to play (Mumani & Stone, 2018; Nancarrow, Wright, & Brace, 1998). A package is not only expected to protect the product, but also to promote it by effectively communicating its characteristics. It can be defined as a system of product, package, and distribution, which perform functions of protection, utility, and communication in physical, atmospheric, and human environments (Lockhart, 1997). Overall, packaging has become a key marketing cue which is capable, by itself, of drawing attention and creating desire (Klimchuk & Krasovec, 2012).

Marketing/communication dimensions of packaging are particularly relevant for low-involvement products such as food. Visits to the supermarket are repetitive (e.g. once a week) and require making many decisions in a short period of time, since it is a routine purchase in which consumers must discriminate and decide between dozens of products very similar to each other (Park, Iyer, & Smith, 1989). Thus, consumers decide which food products to buy by spending a limited amount of time and cognitive resources. Instead of reading and evaluating all the available information from each product (which would imply a great cognitive load), consumers instead rely on certain available cues that allow them to infer a sufficient degree of information relative to the product and its attributes, in order to make quick decisions. Thus, packaging helps consumers decide which product to choose by capturing their attention and convincing

them that it contains the product which best suits their needs (Clement, 2007; Underwood & Ozanne, 1998). As will be further elaborated in the next sections, this means that packaging cues such as shape (Becker, van Rompay, Schifferstein, & Galetzka, 2011), colour (Spence, 2018a), or imagery (Underwood & Klein, 2002) influence consumer perception and response towards the product.

In addition, food packaging has two particularities that reinforce its relevance as a marketing tool. On the one hand, packaging is always present at the point of sale (even in an online environment, where an image of the packaged product is usually shown), so that packaging always mediates the relationship between the product and the consumer at the time of purchase. This is especially important in light of some studies that show that unplanned shopping and in-store decision making have increased in recent years (Gilbride, Inman, & Stilley, 2015). On the other hand, it is worth noting that on many occasions, packaging is also present at the time of product consumption. Products such as drinks, jams, preserves, or snacks are consumed directly from the packaging or with the packaging in sight, and some estimates indicate that the number of products that are consumed directly from their package amounts to one third of the total (Spence, 2017). This implies that packaging cues such as colour (Piqueras-Fiszman & Spence, 2011), weight (Piqueras-Fiszman & Spence, 2012), or even the way the package sounds (Krishna, Cian, & Aydınolu, 2017; Spence, 2016) can exert influence on consumer perception, not only at the buying stage (i.e. when expectations are set) but also on the overall consumption experience.

Given the above, it is easy to realize that the decisions made by the designer during the food packaging design process may influence consumers well beyond mere aesthetic acceptance (for the role of aesthetics on consumer attitude and response, see e.g. Chitturi, Raghunathan, & Mahajan, 2008; Hoegg & Alba, 2008; Reimann, Zaichkowsky, Neuhaus, Bender, & Weber, 2010). When designing a food package, designers have to make many decisions regarding functional aspects of the package. For example, they have to consider the most appropriate size for the packaging in order to favour its handling and storage (besides containing the product), the material that best preserves the protective atmosphere without being very expensive or difficult to open, and so on (Mumani & Stone, 2018). The outcome of all these decisions has obvious potential impacts on production costs, logistics, and safety, so the study of these aspects has attracted great scientific interest so far (Azzi et al., 2012). In contrast, the consequences of design decisions relating to purely visual aspects of

packaging on consumer perception have traditionally been less studied. Given that consumer choice is considered to be mostly driven by the product's visual appearance (Bloch, 1995; Creusen & Schoormans, 2005), visual packaging cues like colour, imagery, or typographies were analysed from an aesthetic point of view (Deng, Hui, & Hutchinson, 2010; Hagtvedt & Patrick, 2014; Hoegg, Alba, & Dahl, 2010) or regarding its ability to capture the attention of the consumer (Clement, Kristensen, & Grønhaug, 2013; Maynard, Munafò, & Leonards, 2013). Only recently have we begun to be aware of the ability of the visual aspects of food packaging to influence the multisensory experience and the attitude of the consumer (Piqueras-Fiszman & Spence, 2015; Spence, 2016).

According to one of the most common design approaches, a key role of design is organising visual communication (Byrne, 1990; Yang & Hsu, 2015). As Frascara (1988, p. 21) puts it, design should not be understood in isolation but only within a communication system. Thus, a packaging designer should not only look for a result that guarantees that all functional requirements are met, but also that has the desired effect on consumer perception and that communicates in an efficient way (Hembree, 2008; Munari, 1973/2016). Consumers infer meaning from each packaging cue (e.g. colours, images, or packaging shape, Ares et al., 2011; Smith, Barratt, & Selsøe Sørensen, 2015; Thomson, 2016), so each cue should be designed with consideration as to what will be its role in the communication process. However, for the designer, it is not easy to anticipate what specific meaning consumers will infer from each of the packaging cues (Smith et al., 2015), although it is crucial to anticipate how each cue will be interpreted and what its effect will be on consumer perception. This is particularly true for the images depicted on the packaging. While images are one of the more salient package features for both designers and consumers and are a prominent communication device (Ampuero & Vila, 2006; Smith et al., 2015; Underwood & Klein, 2002), relatively little research has been devoted to understand their effect on consumer expectations and response. The present dissertation aims to shed light on this matter by assessing, across six studies, how the images depicted on food packaging affect expectations, perception, and response, and the mechanisms by which they are interpreted.

1.2. Background

1.2.1. Food perception

There has been a huge growth of interest in the topic of food perception in recent years. According to Solomon, Bamossy, Askegaard, & Hogg (2008), the perceptual process can be divided in three phases: *selection*, *organisation*, and *interpretation*. The process starts when some of the body sensory receptors receive an input (e.g. when the light reflected from an object reaches the eyes) and the brain selects what parts of it will be processed. Although we receive a huge amount of raw data at every moment through our sensory receptors, only a fraction is further processed; in other words, the brain interprets the world that surrounds us only from fragments. What part of the information is selected and what part is left behind is mainly determined based on consumers' previous experiences (which influences their expectations) and motives (their interests, needs, etc.), which implies that even the same person may perceive differently the same object at different times (Schiffman, Hansen, & Kanuk, 2012). In the next phase, selected information is organised into groups according to the principles described by Gestalt psychology (Spillmann & Ehrenstein, 1996). This process allows consumers to perceive each bit of information not as an isolated stimulus but rather as part of something bigger, which is composed of a pattern of different pieces (Schiffman et al., 2012). Finally, the stimulus is interpreted according to the outcome of the previous processes. However, it should be noted that other factors may have an effect on interpretation, as is the case of the clarity of the stimulus (Schiffman et al., 2012) or the existence of individual differences. In addition to aspects such as consumers' previous experiences or motives, physiological factors such as gender may largely contribute to the subjectivity of the interpretation given to the stimuli (Knez & Kers, 2000; Oliveira-Pinto et al., 2014; Rebollar, Lidón, Guzmán, Gil, & Martín, 2017).

Regarding food products, literature distinguishes among two groups of cues that influence consumer perception: intrinsic and extrinsic cues (Asioli et al., 2016; Olson & Jacoby, 1972). Intrinsic cues refer to properties belonging to the food product itself, which cannot be changed without physically changing the product (e.g. its aroma, taste, colour, or texture). Unsurprisingly, intrinsic cues play a key role in the way consumers experience and perceive food, and therefore have a leading role in consumers' expectations and responses (Olson & Jacoby, 1972). Indeed, when thinking about food and perception, tastes and flavours quickly come to mind as key attributes influencing food perception. Although many researchers emphasise that taste and flavour are different concepts, their contribution to food perception is beyond doubt (Spence, Smith, & Auvray, 2014). Basic tastes refer to the specific gustatory sensations that occur when the receptors located on the tongue are stimulated (i.e. bitter, sweet, salty, sour, and umami; Velasco, Woods, Petit, Cheok, & Spence, 2016), whereas flavour is considered a complex multisensory concept which raises from gustatory, olfactory, and trigeminal inputs (Spence et al., 2014; Spence, 2015a). Even the sound produced by the food when it is being chewed (e.g. the crunchiness of a crisp) is considered to contribute to flavour perception, which in turn may have an effect on overall product perception (Zampini & Spence, 2004).

On the other hand, the extrinsic cues of a food product are all those attributes that surround the product but are not part of it, so they can be changed without altering the product's physical characteristics (Olson & Jacoby, 1972). Although less obvious at first, the influence of food products' extrinsic cues on consumer perception has been well documented (see Piqueras-Fiszman & Spence, 2015; Spence, 2017; Spence & Piqueras-Fiszman, 2014b; for reviews). For example, research has shown that food extrinsic cues such as tableware (e.g. its material, Piqueras-Fiszman, Laughlin, Miodownik, & Spence, 2012; its shape, Lefebvre & Orlowski, 2018; its colour, Tu, Yang, & Ma, 2016; its texture, Biggs, Juravle, & Spence, 2016; its weight, Piqueras-Fiszman, Harrar, Alcaide, & Spence, 2011), atmospheric lighting properties (e.g. illuminance, Rebollar et al., 2017; light colour, Yang, Cho, & Seo, 2016), or packaging may have an effect on consumer expectations, perception, and the overall consumption experience. In fact, packaging has been proven to be a prominent extrinsic cue capable of even influencing sensory perception during tasting (e.g. Krishna et al., 2017; Spence, 2016), although it should be noted that packaging's main contribution to consumer perception occurs during the generation of expectations since the majority of times it is seen prior to consumption.

The brain generates expectations by integrating previously experienced information and all the product-related cues available at the time, which may include intrinsic cues such as the food's visual appearance or aroma (Andersen, Brockhoff, & Hyldig, 2018) and extrinsic cues such as its packaging, the plate on which it is served, or environmental background music (Piqueras-Fiszman & Spence, 2015). Indeed, packaging is a relevant food product extrinsic cue which influence on consumer food perception has been widely recognized. Given that in the majority of cases packaging is available at the buying stage (i.e. prior to food consumption), consumers use it as a diagnostic tool with which to identify and categorise the product (Loken, 2006; Loken, Barsalou, & Joiner, 2008) and to infer the intrinsic attributes of the food (Schifferstein, Fenko, Desmet, Labbe, & Martin, 2013). Thus, packaging plays a prominent role in setting sensory, non-sensory, and hedonic expectations. Indeed, it has been shown to affect sensory expectations, such as the product's flavour (Becker et al., 2011; Piqueras-Fiszman & Spence, 2011); non-sensory expectations, such as the product's healthfulness (Rebollar et al., 2017; van Ooijen, Fransen, Verlegh, & Smit, 2017), naturalness (Machiels & Karnal, 2016; Yang et al., 2016), or quality (Fernqvist & Ekelund, 2014; Walters & Long, 2012); and hedonic expectations (Caporale, Policastro, Carlucci, & Monteleone, 2006; cf. Cardello, 2007). In addition, literature shows that high palatability, healthfulness, quality, naturalness, or hedonic expectations contribute to boosting willingness to buy (e.g. Annett, Muralidharan, Boxall, Cash, & Wismer, 2008; Ares, Giménez, & Gámbaro, 2008; Bower, Saadat, & Whitten, 2003; Fernqvist & Ekelund, 2014; Lee, Shimizu, Kniffin, & Wansink, 2013; Machiels & Karnal, 2016; Román, Sánchez-Siles, & Siegrist, 2017), which highlights the potential effect that packaging has on food choice.

Moreover, previous research has shown that each of the different packaging cues (e.g. colours, imagery, or shape) impact higher-level food inferences, as consumers use symbolic information connoted by each cue to set product expectations and beliefs (Festila & Chrysochou, 2018; Magnier & Schoormans, 2017). Thus, each of the packaging cues is interpreted by consumers and has the potential to affect consumer perception (Becker et al., 2011; Thomson, 2016). Therefore, the question arises as to what happens if the interpretation of one of the package cues is different to that of another one. Take for example the case of a package where the textual claim sends a different message to that of the image depicted on its front. When the interpretation given to a package cue does not match the interpretation elicited from a different one (i.e. the package is perceived as being ambiguous), the package may be considered confusing (or

worse, misleading; Schifferstein et al., 2013; Underwood & Ozanne, 1998). Literature shows that both confusion and ambiguity increase the cognitive load needed to interpret stimuli, which in turn may negatively affect consumers' processing fluency and overall attitude (Alter & Oppenheimer, 2009). In addition, this may probably lead to a disconfirmation of expectations (i.e. a disparity between what was expected and what was actually perceived), which in the context of food packaging relates to negative responses toward the product (cf. Deliza & MacFie, 1996; Piqueras-Fiszman & Spence, 2015). Thus, designers should be able to anticipate how consumers will interpret the different packaging cues so as to prevent confusing or deceptive messages (Smith et al., 2015; Smith, Møgelvang-Hansen, & Hyldig, 2010). To that end, it is key to know how the communication process with the consumer works by looking at the effect of the different packaging cues on consumer perception.

1.2.2. Packaging influence on food perception

Several approaches to classify packaging cues have been proposed aiming to study the processes by which they convey information and thereby influence consumer expectations and perception (Festila & Chrysochou, 2018). Thus, Underwood (2003) made a distinction between *graphic* (e.g. colour, typeface, logos) and *structural* (e.g. shape, size, material) cues, Silayoi & Speece (2007) rather classified them as *visual* (graphics, colour, images, size, and shape) or *informational* (labels, textual claims), and more recently Festila & Chrysochou (2018) combined both approaches by proposing to classify them as *informational*, *graphic*, or *structural*. This latter approach is meant to highlight the different ways by which each of these cues generate product-related inferences and influence consumer behaviour, and also allows to distinguish them both by the form they take and by how explicitly they convey information (Festila & Chrysochou, 2018). Thus, *informational* cues are those characterised by communicating the message most explicitly (namely, textual claims), *graphic* cues are those which convey meaning through symbolic associations and are usually printed on the label (e.g. colour, images, or typographies), and *structural* cues are those that have a mainly functional role (although still are used by consumers to infer implicit meaning, such as packaging shape or material).

From a semiotic point of view, any of these approaches is characterised by considering each packaging cue as a sign from which consumers infer meaning (cf.

Opperud, 2004). Based on the definition of Peirce (1867–1893/1992), Smith et al. (2010, p. 1019) refer to a sign as "something that stands for something (else) to somebody." Thus, each packaging sign (i.e. each packaging cue such as colour, images, shape, and so on) is used to identify the product, to categorise it, and to infer expectations about its attributes (Smith et al., 2015). Also drawing on the semiotic theory developed by Peirce (1867–1893/1992), Ares et al. (2011) propose that two main types of signs can be distinguished in the context of food packaging: *linguistic* signs and *visual* signs. According to this approach, linguistic signs are those that produce meaning mainly by social convention (e.g. textual claims), whereas visual signs produce meaning mostly by resemblance (e.g. colours, shapes, and images).[1]

The role played by packaging linguistic signs in consumers' communication and perception processes has been widely studied to date (Lähteenmäki, 2013; Piqueras-Fiszman & Spence, 2015; Spence & Piqueras-Fiszman, 2014a). In a given food package, it is common to find one or more of the following linguistic signs: a description of the product/trade name, which may also include information about the subcategory to which it belongs; claims about its sensory or hedonic characteristics, about its functional benefits, or about how it has been processed; besides nutritional information or indications about its origin. Literature shows that each of these signs have been shown to have an effect on consumer expectations and response. For example, Yeomans, Chambers, Blumenthal, & Blake (2008) found that participants who evaluated a smoked-salmon ice-cream labelled as "ice-cream" disliked it more and judged it as being saltier and tastier than participants who tasted it labelled as "frozen savoury mousse" or "food 386," and discussed their results in terms of a strong disconfirmation of expectations. However, although the role of linguistic signs is mainly to inform the consumer and to communicate explicit meaning, it should be noted that linguistic signs may also be misinterpreted due to their intrinsic degree of ambiguity (Smith et al., 2015, p. 72) or to the influence of cognitive biases such as the halo effect (Nisbett & Wilson, 1977). Hence, research suggests that consumers tend to associate unrelated concepts such as 'organic'

[1] However, it is worth noting that visual signs can also produce meaning through conventions (e.g. milk packaging colour codification), and linguistic signs can sometimes produce meaning through resemblance (e.g. onomatopoeias).

and 'healthy' (Schuldt, Muller, & Schwarz, 2012), and that labelling foods as 'healthy', 'light', or 'low-calorie' may lead consumers to overestimate the food's health benefits (Roe, Levy, & Derby, 1999) or may lead to overconsumption in restrained eaters (Cavanagh, Kruja, & Forestell, 2014). For example, Sütterlin & Siegrist (2015) demonstrated that describing sugar as 'fruit sugar' instead of just 'sugar' in the nutritional information of breakfast cereals made people judge them as being more healthful due to the health associations raised by the word 'fruit.'

In contrast, visual signs operate by generating higher-level inferential processes that are used to set expectations and to interpret meaning (Festila & Chrysochou, 2018), so they have also been shown to influence consumer expectations and response to food. In contrast to linguistic signs, visual signs mostly convey meaning in symbolic and metaphorical terms, so its interpretation is less unequivocal (Smith et al., 2015). Their communicative potential mostly relies on their iconicity and their indexicality (i.e., their immediate resemblance to the object they stand for and their association to real-life experience, respectively), but it also may be based in symbolic meanings assigned by convention (as in particular cases in which colour is used to code subcategories within a wider product category) (Smith et al., 2010). Images, colours, typefaces, and even mainly functional cues such as packaging shape and material are among the most common visual signs that communicate meaning in any food package.

Indeed, literature shows that the communicative ability of packaging shape and material should not be overlooked. Aiming to assess how consumers categorise food products, Arboleda & Arce-Lopera (2015) demonstrated that packaging shape communicates the category to which the product belongs by conducting an experiment in which participants had to categorise a number of bottle silhouettes. In addition, Parise & Spence (2012) showed that packaging shape has the ability to convey specific brand attributes such as "powerful" or "gentle", implying that the shape of a package can elicit associations that influence consumer behaviour. Similarly, Festila (2016) and van Ooijen et al. (2017) demonstrated that packaging shape can be used to convey healthfulness. On the other hand, some studies have documented that consumers judge product naturalness and sustainability by relying on packaging material (Labbe, Pineau, & Martin, 2013; Magnier & Schoormans, 2015, 2017; Magnier, Schoormans, & Mugge, 2016). However, other researchers have shown that consumers'

sustainability evaluations based on packaging material may not be accurate, since they can be misled by the package's other visual signs (Steenis, van Herpen, van der Lans, Ligthart, & van Trijp, 2017).

Typefaces are other key visual signs commonly used in food packaging. The textual claims shown on a package do not only convey meaning by their semantic message, but also through the typographic font chosen to depict them. Designers have intuitively known for many years the expressive capacity of typographies, and there are many books and web pages devoted to understanding the peculiarities of typefaces and their recommended uses (e.g. Bringhurst, 2004; Carter, Meggs, Day, Maxa, & Sanders, 2015; Lupton, 2010). From a scientific point of view, the interest in understanding the mechanisms by which typographic fonts emit meaning began several decades ago and has continued since then (Tannenbaum, Jacobson, & Norris, 1964). As a result, we know that typefaces do not only have a denoted meaning (i.e. the semantic meaning of the text they stand for), but also carry their own connotative meaning (i.e. the emotional associations and symbolisms they elicit). Therefore, a typeface is considered appropriate in relation to other stimulus when the connotative meaning of both coincides (Bottomley, Doyle, & Bottomley, 2002; Childers & Jass, 2002; Doyle & Bottomley, 2004, 2009). Moreover, a typeface's connotative meaning has been suggested to be processed prior to text's semantic meaning, which may influence subsequent information processing (Velasco, Woods, & Hyndman, 2015). Although the effect of typefaces' elicited meaning has not yet been systematically assessed in the context of food packaging, some studies shed light on its relevance as a package visual sign. Thus, typefaces have been shown to be able to communicate the exotic origin of a product (especially when both the font's connotative meaning and the text's denotative meaning are congruent, Celhay, Boysselle, & Cohen, 2015) and can be used to suggest specific product attributes such as its healthfulness (but only to individuals with a high health-promotion focus, Karnal, Machiels, Orth, & Mai, 2016) or its taste (with rounded fonts enhancing sweetness expectations and angular fonts boosting sourness expectations, Velasco, Salgado-Montejo, Marmolejo-Ramos, & Spence, 2014; Velasco, Woods, & Hyndman, 2015).

In contrast to other visual signs such as packaging shape, material, or typefaces, the role of colour as a visual sign in the context of food packaging has attracted great scientific interest and is now well known. All packages are coloured and the colour occupies a large part of the surface of the pack, which makes it a key visual

sign to communicate to consumers (Kauppinen-Räisänen, 2014; Wei, Ou, Luo, & Hutchings, 2014) and to understand purchasing and food choice processes (Labrecque, Patrick, & Milne, 2013; Singh & Satyendra, 2006). Colour is considered to be the visual sign that triggers the fastest response (Swientek, 2001) and to have a lasting effect on consumers (Kauppinen-Räisänen, 2014). However, whereas some effects of colour on consumer perception are thought to be automatic and universal (such as the effect it produces on arousal and excitement, Labrecque & Milne, 2012; see also Spence, 2015b, 2015c; Spence & Piqueras-Fiszman, 2016), it should be noted that the symbolic meanings associated to colour are culture-dependent (Aslam, 2006; Madden, Hewett, & Roth, 2000; Saito, 1996).

As opposed to the colour of other elements that surround food (such as tableware, e.g. Tu et al., 2016; walls, e.g. Schifferstein, Howell, & Pont, 2017; or lighting, e.g. Yang et al., 2016), packaging colour is assumed to communicate information related to the product. In fact, according to estimates, more than 90% of food brands use colour as a visual sign with which to communicate what kind of product can be found inside the package (Spence, 2018a). Thus, consumers use packaging colour to infer specific product attributes such as its flavour or its healthfulness. Regarding flavour, Piqueras-Fiszman, Velasco, & Spence (2012) showed that consumers may infer the flavour of a product contained within a package either because a learned association with the brand already exists or because the colour of the container represents the colour of its primary named ingredients. Moreover, Piqueras-Fiszman & Spence (2011) demonstrated that consumers may be unable to identify the flavour of a product if the congruence between packaging colour and product flavour is manipulated. As for the product healthfulness, Schuldt (2013) showed that consumers consider more healthful a candy bar that comes in a green package than in a red one, even when caloric information remains the same. In addition, other colour properties such as saturation/brightness or perceived weight have been proven to influence consumer interpretation and response. Thus, Tijssen, Zandstra, de Graaf, & Jager (2017) and Mead & Richerson (2018) suggest that consumers associate muted and watered packaging colours with healthful foods (in contrast to vivid and saturated/bright colours), although Tijssen et al. (2017) warn that consumers also associate muted colours with less tasty and less attractive products (thus potentially reducing their appeal). Finally, Karnal et al. (2016) demonstrated that colour-perceived weight affects product-perceived healthfulness, sugar content, and calorie content: in their experiment, a package with a light colour (yellow) was judged as being more healthful than a package with a heavy colour (red).

1.2.3. Packaging imagery influence on food perception

Many of the food packages that can be found in any supermarket come with one or more images depicted on their front, which makes imagery a key element in packaging visual appearance (Ampuero & Vila, 2006; Liao, Corsi, Chrysochou, & Lockshin, 2015; Rebollar, Lidón, Martín, & Puebla, 2015). For designers, it is one of the graphic elements that offers the most possibilities, both in terms of aesthetics and communication. For consumers, it is particularly important since it lets them know about the visual aspect of the product before buying it, thereby making it a key element in the generation of expectations (Jaeger & MacFie, 2001; Underwood & Klein, 2002). Despite being a prominent package cue, the study of packaging imagery has attracted modest scientific attention thus far (see Hine, 1995, for an historical account on the topic). However, the devoted literature shows that each of the different features of the images depicted on food packaging has the ability both to convey meaning and to affect consumer perception. Some of the image's features that have been studied to date are the image's subject, size, pictorial style, and location.

One of the most prominent features of packaging imagery is what is depicted in it (i.e., its subject). Depicted subjects vary, although the most common case is to show the product contained inside the package (Underwood & Klein, 2002). It can be displayed in its raw form, during cooking, or ready for consumption; by itself, in a serving suggestion (i.e. accompanied by other products not included within the package), or maybe with or without tableware (e.g. Kobayashi & Benassi, 2015; Underwood & Klein, 2002). Additionally, packages may display images of environments that idealize the supposed origin of the product (e.g. a farm, a natural landscape, Celhay & Remaud, 2018; Tempesta et al., 2010) or the ingredients that confer it its main flavour (e.g. wheat, a cow, Smith et al., 2015). Moreover, packages occasionally show people adopting different roles (e.g. cook, prescriber, or consumer, Bone & France, 2001) or celebrities' endorsements (Dixon et al., 2014), not to mention trade characters that create a product identity and promote brand personality (Castonguay, Kunkel, Wright, & Duff, 2013).

Overall, images can be classified as those that show the product and those that show other subjects. This distinction is useful due to the fact that food images are salient stimuli that quickly and involuntarily attract consumer attention (di Pellegrino, Magarelli, & Mengarelli, 2011; Nijs, Muris, Euser, & Franken, 2010; Spence, Okajima, Cheok, Petit, & Michel, 2015), increase salivation and appe-

tite (Spence, 2011; Wansink, 2004), and, thereby, may enhance willingness to buy (Wilcock, Pun, Khanona, & Aung, 2004). Indeed, some studies suggest that consumers increasingly demand to see the product before opening the package (Azzi et al., 2012), which can be done through images or transparent materials. In fact, mainly due to technological progress and the development of new materials, more and more packages display transparent windows that allow the consumer to see directly the product contained inside, so that its influence on the consumer has begun to attract a scientific interest (Deng & Srinivasan, 2013; Simmonds & Spence, 2017; Simmonds, Woods, & Spence, 2017).

Underwood & Klein (2002) conducted one of the first studies which analysed the effect of packaging images on consumer judgments and beliefs towards the product. They assessed the effect of showing an image of the product on the packages of three product categories (candy, bacon, and margarine), and they found that consumers consistently preferred the packaging which depicted the image of the product above those which did not (both for familiar and non-familiar brands). In fact, the packages displaying an image of the product were judged as being more palatable, more healthful, and more attractive, indeed suggesting the influence of packaging imagery on consumer expectations. Since then, a modest but growing number of studies have assessed how showing food imagery on packaging influences consumer expectations and response. Thus, Miraballes, Fiszman, Gámbaro, & Varela (2014) demonstrated that depicting the product on the packaging elicits sensory associations related to texture, appearance, and taste, whereas Gvili et al. (2015) and Gvili, Tal, Amar, & Wansink (2017) indicated that showing the product moving rather than still increases perceived freshness, food acceptance, and taste expectations. Moreover, Smith et al. (2015) showed that depicting the major taste-giving ingredient increased the quantity of natural product believed to have been used in the product elaboration (although consumers' food knowledge level moderates this effect). In one of the few studies that assessed the effect of the image not on expectations but on actual perception (together with that of Machiels & Karnal, 2016), Sakai & Morikawa (2006) and Mizutani et al. (2010) showed that seeing product-congruent and positive-valenced images during consumption led to higher taste evaluations and a positive attitude towards the product (as opposed to seeing product-incongruent or negative-valenced images).

On the other hand, images that don't depict the product contained within the package usually have a symbolic meaning and require a metaphorical (rather

than a literal) interpretation. Thus, these kinds of images do not intend to represent objective depictions of reality, but rather are visual metaphors capable of producing higher-level inferences about the product's expected attributes (Festila & Chrysochou, 2018). Although not many yet, a number of studies have assessed how visual metaphors are interpreted in food packaging and how they influence consumer expectations and responses (Fenko, Vries, & Rompay, 2018; Festila, 2016; Machiels & Karnal, 2016). In this regard, Bone & France (2001) conducted a seminal study in which participants had to estimate the caffeine content of two cola drinks: whereas one label was red and depicted a football player (high-caffeine graphic), the other was blue and depicted a sleeping man under a palm tree (low caffeine graphic). Caffeine content was therefore symbolically conveyed through the attitude of the persons depicted on the packaging and through background colour. Despite both labels displaying the same textual information, in which the caffeine level of the product was explicitly indicated, they found that consumers interpreted both labels in the intended way, as the high-caffeine graphic label was judged as having a higher caffeine content (and the opposite happened for the low-caffeine graphic label). However, it should be noted that their findings cannot be attributed solely to the effect of the image, since both images and colours varied in each manipulation. More recently, Fenko et al. (2018) demonstrated that the perception of a product's attribute (in their experiment, coffee strength) can be enhanced if it is conveyed through a visual metaphor (the image of a lion), whereas Chrysochou & Grunert (2014) suggested that perceived healthfulness can be enhanced by the depiction of health imagery (i.e. images that have a symbolic health-related meaning, such as people exercising). Furthermore, Liao et al. (2015) showed that packaging images can be used to modulate consumer emotional response, which can be measured by self-report or through physiological measures.

Regarding other features of packaging imagery beyond their subject, some studies have analysed how the size of the image influences consumer perception. Thus, Neyens, Aerts, & Smits (2015) demonstrated that children increase milk and cereal consumption when exposed to a large serving suggestion image size as compared to a smaller image. Similarly, Madzharov & Block (2010) found that the number of product units displayed on the package biases the estimation about the number of product units contained within and influences consumption (the more units displayed, the more there are believed to be, and more is consumed). Szocs & Lefebvre (2017) documented a similar heuristic

judgment regarding product presentation, since they found that consumers perceive portions as smaller when are depicted vertically (i.e. stacked on the plate) than if depicted horizontally (i.e. spread across the plate). However, in contrast to Madzharov & Block's (2010) results, participants consumed less when the perceived quantity was larger. Moreover, Versluis, Papies, & Marchiori (2015) demonstrated that conveying serving size recommendations through images rather than verbally helps people to modulate consumption, diminishing the pack size effect (by which people tend to increase food consumption from large packages). As for the image's pictorial style, Deliza, MacFie, & Hedderley (2003) and Smith et al. (2015) studied whether displaying a drawing or a photograph of the product influences consumer expectations. Interestingly, whereas Smith et al. (2015) failed to find such an effect, Deliza et al. (2003) found that the image was an influential cue in almost all the case studies since the juice packages showing a drawing (rather than a photograph) of a passion fruit raised higher sensory, non-sensory, and hedonic expectations. In addition, they found that the effect of the image was particularly important for participants with low need for cognition, i.e. those who tended to pay attention to the details. Regarding the image's orientation, Velasco, Woods, & Spence (2015) indicated that for some products, the orientation in which the image is shown has also the ability to affect evaluations, since some images' orientations were preferred over others. However, consumers were not always willing to pay more for the packages in which the preferred orientation was displayed, showing that further investigation is needed in this vein. Finally, regarding where the image is placed within the package, Deng & Kahn (2009) found that the image's spatial location can convey the notion of heaviness: placing the image on the visually heavier locations (i.e. bottom, right, or bottom-right positions of the package) enhanced willingness to buy (cf. Kahn & Deng, 2010; see also Fenko et al., 2018).

Since the images depicted on packaging are key visual signs from which consumers infer meaning and set expectations, it is relevant for the designer to understand the processes and mechanisms by which this interpretation process takes place. According to Sperber & Wilson's (1995) principle of relevance, and regardless of the subject depicted in the image, consumers will assume that the image is situationally relevant and will therefore try to interpret it according to its context. In other words, consumers will expect that any information sent through the package cues will be relevant in that context, so the cues' possible meanings will be limited to those that make sense in that context. For example,

if a food product is depicted on a food package, consumers will assume that the product depicted represents the product contained in the package (so if the difference between the two is very large, consumers will probably feel deceived, Schifferstein et al., 2013; Underwood & Ozanne, 1998).

Once the image's situational relevance has been set (e.g. whether it represents the product itself, the product flavour, or a metaphor about the product's attributes), it has to be further processed in order to determine its definitive meaning (Smith et al., 2015). However, it should be highlighted that the perceptual and cognitive mechanisms by which consumers interpret an image are far from being straightforward, since they greatly differ from those needed to interpret a linguistic sign. For several decades, researchers have taken different approaches in order to study the differences between how texts and images are interpreted (cf. Smith et al., 2015). Literature shows that regarding cognitive processes, images produce different responses and require different processing levels (Kauppinen-Räisänen, Owusu, & Abeeku Bamfo, 2012). In fact, images are more vivid and their processing requires less cognitive effort, so they have been suggested to generate expectations more quickly than linguistic signs (Kisielius & Sternthal, 1984; Mueller, Lockshin, & Louviere, 2009; Underwood & Klein, 2002).

Based on Messaris's (1994, 1997) elaboration on the trichotomy of signs originally proposed by Peirce (1867–1893/1992), Smith et al. (2015) expound the three main properties that distinguish images from linguistic signs according to semiotic theory: *iconicity*, *indexicality*, and *propositional* (syntactic) *indeterminacy*. Iconicity refers to the fact that, contrarily to linguistic signs, images do resemble the objects they depict (although this is not always the case; see also Scott, 1994). Their processing thus involves the visual system, which in turn has associative connections to other systems such as those underlying taste and reward. As it has already been discussed, this helps to explain why seeing food activates processes related to appetite and salivation (Spence, 2011; Wansink, 2004). Regarding images, indexicality alludes to the fact that photographs are direct physical imprints of the object they depict, since they are created by capturing the light reflected by the physical object (Messaris, 1997). Although the degree of this documentary status varies depending whether the image is a photograph or an illustration, the indexical ability of an image clearly sets it apart from linguistic signs (Messaris, 1997).

Finally, according to Messaris (1997, p. xiii), propositional (syntactic) indeterminacy is the characteristic syntactic property of visual syntax. It refers to the fact that an image by itself is ambiguous and can evoke many interpretations in the mind of the consumer, since it lacks the syntactic devices necessary to emit an explicit propositional meaning (Messaris, 1997; Smith et al., 2015). Take for example the case of depicting a strawberry on a yoghurt package. Consumers could interpret it as meaning that the yoghurt is made with strawberries, has strawberries on it, has strawberry flavour, and so on, and nothing in the image will give a clue as to which is the correct interpretation (Smith et al., 2015). Thus, consumers will make sense of the image according to the image situational relevance (Sperber & Wilson, 1995) and by using mechanisms such as those proposed by the slot/filler and analogy approaches (Smith et al., 2015). Whereas the slot/filler approach states that the probabilities of opting for one of the possible meanings of the sign (filler) will be greater the better it fits with any of the possible attributes of the object (slot) (Fillmore & Baker, 2010; Lynott & Connell, 2010; Smith, Osherson, Rips, & Keane, 1988), the analogy approach proposes that the interpretation that has proved valid in similar past combinations will be preferred (Estes & Jones, 2006; Gagné & Spalding, 2006; van Jaarsveld, Coolen, & Schreuder, 1994; see also Gregan-Paxton & John, 1997).

Overall, despite the fact that some authors have suggested that an image's propositional indeterminacy should be considered a strength (rather than a weakness) in persuasion contexts such as advertising (Messaris, 1997), or that some contextual elements such as linguistic signs have been proposed to narrow the possible interpretations given to the image due to an anchoring effect (see Barthes, 1977), communication through images is considered to be "weak" since the receptor can never be sure what the sender had in mind or the way in which the stimulus should be interpreted (Sperber & Wilson, 1995, p. 175). Indeed, this is the main reason by which designers find it so hard to anticipate the meaning that consumers will infer from a given image: they must understand and untangle the codes and language used by consumers (Frascara, 1988; Laing & Masoodian, 2016) in order to posit the desired message as unambiguously as possible, since confusion or misunderstanding could lead to setting erroneous expectations.

1.3. Methodological considerations

From a methodological point of view, previous research regarding these issues has relied on techniques coming mostly from the fields of experimental psychology and sensory science (cf. Ares & Varela, 2018a, 2018b), and to a lesser extent, from neuroscience (Stasi et al., 2018). Thus, consumer perception and response are commonly measured by means of self-report scales, projective techniques, psychophysical experiments, implicit behavioural tasks, neuroscience techniques, or a combination of those. Indeed, some studies have conducted experiments in which several techniques have been combined in order to get deeper insights of the processes studied (e.g. eye-tracking and word association, Piqueras-Fiszman, Velasco, Salgado-Montejo, & Spence, 2013). Given that research in this field seeks to understand human perception and human behaviour, it is mainly based on human subject research. Besides the obvious ethical considerations that this entails, investigating with people implies that the techniques by which perception and response are measured can be classified depending on the consciousness level of the responses given by the participants (De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009; Gawronski & De Houwer, 2014). Thus, measurement techniques can be classified as being either *explicit* or *implicit*.[2]

[2] However, it should be noted that the line separating the explicit (conscious) from the implicit (unconscious) processes is not as clear as one might think, and the debate of how truly automatic are some of the processes traditionally regarded as implicit is still ongoing (Getz & Kubovy, 2018; Spence & Deroy, 2013). Moreover, some researchers consider that techniques such as word association (or other projective techniques) may be located somewhere in the middle of the explicit-implicit scale, since they are thought to allow access to implicit consumer associations but also imply a certain degree of reasoning (Stacy, Ames, & Grenard, 2006). Nonethe-

Explicit measurement techniques are quick and easy to conduct, and have been proven to offer a reliable approach to understand consumer perception and to anticipate consumer response (Ares & Varela, 2018a; Asioli et al., 2016; Hendrick, Fischer, Tobi, & Frewer, 2013; Petty & Cacioppo, 1996; Thomas & Chambault, 2016). Methods such as conjoint analysis (e.g. Deliza et al., 2003; Kim, Lopetcharat, & Drake, 2013; Silayoi & Speece, 2007), Likert scales and questionnaires (e.g. Becker et al., 2011; Te Vaarwerk, van Rompay, & Okken, 2015; Van Rompay & Pruyn, 2011), check-all-that-apply (e.g. Puyares, Ares, & Carrau, 2010), focus groups (e.g. Fernqvist, Olsson, & Spendrup, 2015; Schifferstein et al., 2013), projective techniques (e.g. Ares & Deliza, 2010; Piqueras-Fiszman et al., 2013) or semiotic analysis (e.g. Ares et al., 2011; Celhay & Remaud, 2018; Piqueras-Fiszman, Ares, & Varela, 2011) have been used to study how packaging cues influence consumer perception and response (cf. Thomas & Chambault, 2016) from different perspectives. These techniques can be conducted both in the laboratory and also on the web thanks to online testing platforms such as Survey Monkey, Mechanical Turk, and Prolific Academic, which allows reaching a greater number of participants and even selecting specific cohorts of people (Woods, Velasco, Levitan, Wan, & Spence, 2015).

On the other hand, implicit measurement techniques allow researchers to access a type of mental structure and information currently inaccessible from other means (Bar-Anan & Nosek, 2014; Nosek, Hawkins, & Frazier, 2011; see also chapters 9–12 from Ares & Varela, 2018b). These insights have proven to be valuable for predicting human behaviour, since most human cognition occurs without the individual being aware of it: indeed, literature shows that unconscious cognition has a strong effect on consumer judgments, attitude, and perception (Greenwald & Banaji, 1995; Nosek et al., 2011). Thus, the access that these methods give to implicit cognition and the development of reliable and cheap technology devoted to this purpose help to explain their growing popularity (Kraus & Piqueras-Fiszman, 2018; Nosek et al., 2011; Teige-Mocigemba, Klauer, & Sherman, 2010). Traditional implicit techniques mostly rely on time-based measurement methods (Bar-Anan & Nosek, 2014; Goodall, 2011)

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less, the classification of methods according to their implicitness is overall regarded as useful as it reflects the underlying processes proposed by dual process theories (Dijksterhuis, 2013; Gawronski & Creighton, 2013).

and can be divided into those based on the Implicit Association Test (IAT, Greenwald, McGhee, & Schwartz, 1998; Greenwald, Nosek, & Banaji, 2003; Lane, Banaji, Nosek, & Greenwald, 2007) and those based on sequential priming paradigms (Gawronski & De Houwer, 2014; Goodall, 2011; Wentura & Degner, 2010). Although still modest, the number of studies that have used these techniques to assess how packaging cues affect consumer perception have grown in recent years (Fulcher, Dean, & Trufil, 2016; Kraus & Piqueras-Fiszman, 2018). Thus, speeded classification tasks (such as IAT) have been used to investigate the associations between packaging colour and product flavour (Piqueras-Fiszman & Spence, 2011; Piqueras-Fiszman et al., 2012), between packaging colour and product healthfulness (Mai, Symmank, & Seeberg-Elverfeldt, 2016), between packaging typefaces and product healthfulness (Karnal et al., 2016), or between packaging shape and brand attributes (Parise & Spence, 2012). In turn, more recent implicit techniques coming from the field of neuroscience are commonly based on measuring eye movements, physiological responses from the autonomic nervous system, or the exploration of brain activity (Spinelli & Niedziela, 2016; Stasi et al., 2018). While methods such as eye-tracking have been widely used to investigate consumer response towards food packaging (e.g. Piqueras-Fiszman et al., 2013; Rebollar et al., 2015; van Herpen & Trijp, 2011), other physiological measurements such as skin conductance response (SCR), facial electromyography (EMG), or functional magnetic resonance imaging (fMRI) have been barely used thus far (e.g. see Liao et al., 2015; and Reimann et al., 2010; respectively).

To summarize, both explicit and implicit measurement techniques have their own limitations. Whereas explicit techniques do not guarantee that participants' responses reflect their true attitudes (Fulcher et al., 2016; Petty & Cacioppo, 1996), the IAT does not allow addressing the mechanisms driving its effects (Goodall, 2011). In addition, some studies have questioned the ability of implicit techniques such as the IAT to access purely implicit attitudes, since they have shown that IAT results can be faked under certain circumstances (De Houwer, Beckers, & Moors, 2007). In turn, the cost, the invasiveness and the lack of ecological validity have hindered the popularization of neuroscience techniques such as EMG, SCR, or fMRI (Spinelli & Niedziela, 2016). Thus, literature suggests that an appropriate combination of methods is key to understanding the mechanisms underlying the processes of consumer perception and response (Karmarkar & Plassmann, 2015; Perugini, 2005; Spinelli & Niedziela, 2016). Whereas explicit measurement techniques such as self-report scales, projective

techniques, or psychophysical experiments may allow reliably studying consumer perception and response towards packaging imagery (Thomas & Chambault, 2016), conducting speeded classification tasks would be useful in order to assess implicit consumer associations (Kraus & Piqueras-Fiszman, 2018).

Furthermore, in recent years there has been a growing interest in increasing the ecological validity of the experiments in this field (Ares & Varela, 2018a, 2018b; Lawless & Heimann, 2010). Given that most of the research is done in a laboratory setting and uses ad-hoc designed stimuli, many researchers question the extent to which the results obtained in the lab represent what happens in the outside world. Regarding where the experiment is conducted, several approaches have been taken in the literature. Whereas some researchers have sought a more realistic and immersive experience by using virtual environments (Bangcuyo et al., 2015; Ploydanai, van den Puttelaar, van Herpen, & van Trijp, 2017; van Herpen, Immink, & van den Puttelaar, 2016), others have conducted their studies directly on the consumption environment (e.g. at a supermarket, Becker et al., 2011; in a winery, Oberfeld, Hecht, Allendorf, & Wickelmaier, 2009; or in the home environment of the participants Lagerkvist, Okello, Muoki, Heck, & Prain, 2016). Regarding stimuli design, Deliza et al. (2003) were among the first to use computer-generated images of the packages to be evaluated, and since then most research has relied on ad-hoc designed stimuli in order to avoid bias from previous experience. In order to increase the ecological validity of the experiment, participants should believe that the stimuli they are evaluating are not mock-ups but rather real products. However, it is worth noting that this has been a common limitation of previous research devoted to assessing the influence of packaging cues on consumer perception and response, since computer images or other elements have rather been used as proxies for actual packages (e.g. Becker et al., 2011; Machiels & Karnal, 2016; Mizutani et al., 2010). In other words, to achieve an immersive experience, literature suggests that not only the setting, but also the stimulus used in the experiment should be as realistic as possible (Bangcuyo et al., 2015).

1.4. Rationale and objectives

Each packaging cue should be designed considering what will be its role in the communication process, since consumers use them to infer information and set expectations about the product. Thus, the message elicited by each packaging cue should be aligned in order to avoid confusion and misinterpretation: in fact, research has shown that even using accurate verbal labelling does not avoid any misunderstanding presented graphically (Bone & France, 2001), since visual signs are processed more rapidly than linguistic signs. In other words, designers should be aware of both the way in which all the different cues present in the package will be interpreted and the effect that these may have on consumer perception, since all cues must convey a coherent message to allow for consumer understanding and market success (Piqueras-Fiszman & Spence, 2015).

Although a great deal of research has been made trying to understand how packaging cues convey meaning and thereby affect perception, we are still far from fully understanding how the different cues contribute to this process. Specifically, the role of packaging imagery has only received modest attention thus far, despite being a prominent visual sign from which consumers infer meaning. For example, the influence of the image's own features (e.g. its subject, its shape, its rhetorical style) on consumer expectations and response is still almost unexplored, and the same is true for the image's impact on perception during tasting. However, it is essential for designers to know the impact of packaging imagery decisions since images may affect consumer perception and response in an unintended way.

In addition, images tend to be ambiguous due to their propositional indeterminacy (Smith et al., 2015), which makes it difficult to anticipate how they will be interpreted by the consumer. Yet little is known about the mechanisms by which images are interpreted despite it being crucial to ensure desired meanings are

elicited. Moreover, according to sensory science literature, it is also reasonable to wonder whether it would be possible to use some certain image features such as its shape to convey product information to consumers, thus helping to break the indeterminacy of the image (Velasco et al., 2016). In sum, it is in the interest of not only designers, but also producers and policymakers to be able to anticipate how consumers will interpret the images depicted on the package so as to prevent confusing or deceptive messages (Smith et al., 2010, 2015).

Given the above, two main and five secondary objectives are addressed in this thesis across six research studies (Table 1):

Objective 1.

To study whether manipulating the subject shown on packaging imagery influences consumer expectations, perception, and response towards the product.

Ob 1.1. To study whether manipulating how a product attribute is conveyed through imagery affects consumer expectations and willingness to buy.

Ob 1.2. To study whether manipulating the way in which the product is depicted affects consumer expectations, consumer beliefs towards the product, willingness to buy, and perception during tasting.

Objective 2.

To study how consumers infer meaning from an ambiguous image.

Ob 2.1. To study the mechanism by which meaning is inferred from an ambiguous image.

Ob 2.2. To study the influence of the image rhetorical style (i.e. whether it is literal or metaphorical) on the cognitive effort needed to process it.

Ob 2.3. To study whether the interpretation given to an image can be modulated by manipulating its shape.

Table 1

List of objectives addressed in each study.

Objectives			Studies					
			1	2	3	4	5	6
1.	To study whether manipulating the subject shown on packaging imagery influences consumer expectations, perception, and response towards the product.		**x**	**x**	**x**	**x**	**x**	**x**
1.1.	To study whether manipulating how a product attribute is conveyed through imagery affects...	consumer expectations	**x**	**x**	-	-	**x**	**x**
		willingness to buy	**x**	**x**	-	-	-	-
1.2.	To study whether manipulating the way in which the product is depicted affects...	consumer expectations	**x**	-	**x**	-	-	-
		consumer beliefs towards the product	-	-	**x**	-	-	-
		willingness to buy	**x**	-	**x**	**x**	-	-
		perception during tasting	-	-	-	**x**	-	-
2.	To study how consumers infer meaning from an ambiguous image.		-	-	-	-	**x**	**x**
2.1.	To study the mechanism by which meaning is inferred from an ambiguous image.		-	-	-	-	**x**	**x**
2.2.	To study the influence of the image rhetorical style (i.e. whether it is literal or metaphorical) on the cognitive effort needed to process it.		-	-	-	-	**x**	-
2.3.	To study whether the interpretation given to an image can be modulated by manipulating its shape.		-	-	-	-	-	**x**

2. THESIS OUTLINE

2.1. Thesis outline

Across six studies, this thesis investigates how packaging imagery influences consumer perception and response by taking an interdisciplinary approach. The first four studies assess how manipulating the subject shown on the images depicted on food packaging influences consumer expectations, perception and response towards the product **(objective 1)**, whereas the remaining two studies investigate the mechanism by which meaning is inferred from an ambiguous image depicted on food packaging **(objective 2)**. From a methodological point of view, these objectives are addressed from an interdisciplinary approach by conducting different experimental methods and by using realistic stimuli. Thus, the body of this thesis consists in a compilation of six manuscripts, of which five have been published in international JCR scientific journals and one has been submitted for publication:

- **Study 1** p. 57
  Rebollar, R., **Gil, I.**, Lidón, I., Martín, J., Fernández, M. J., & Rivera, S. (2017). How material, visual and verbal cues on packaging influence consumer expectations and willingness to buy: The case of crisps (potato chips) in Spain. *Food Research International*, *99*, 239–246. https://doi.org/10.1016/j.foodres.2017.05.024

- **Study 2** p. 67
  Rebollar, R., Lidón, I., **Gil-Pérez, I.**, & Martín, J. (2018). Images used to convey that a natural yogurt is sweetened influence consumer expectations and willingness to buy. *Manuscript submitted for publication to the Journal of Dairy Science*.

- **Study 3** p. 109
  Rebollar, R., Lidón, I., **Gil, I.**, Martín, J., Fernández, M. J., & Riveres, C. E. (2016). The influence the serving suggestion displayed on soft cheese packaging has on consumer expectations and willingness to buy. *Food Quality and Preference*, *52*, 188–194. https://doi.org/10.1016/j.foodqual.2016.04.015

- **Study 4** p. 119
  Lidón, I., Rebollar, R., **Gil-Pérez, I.**, Martín, J., & Vicente-Villardón, J. L. (in press). The influence the image of the product shown on food packaging labels has on product perception during tasting: Effects and gender differences. *Packaging Technology and Science*. https://doi.org/10.1002/pts.2407

- **Study 5** p. 131
  Gil-Pérez, I., Rebollar, R., Lidón, I., Piqueras-Fiszman, B., & van Trijp, H. C. M. (2019). What do you mean by hot? Assessing the associations raised by the visual depiction of an image of fire on food packaging. *Food Quality and Preference*, *71*, 384–394. https://doi.org/10.1016/j.foodqual.2018.08.015

- **Study 6** p. 145
  Gil-Pérez, I., Rebollar, R., Lidón, I., Martín, J., van Trijp, H. C. M., & Piqueras-Fiszman, B. (2019). Hot or not? Conveying sensory information on food packaging through the spiciness-shape correspondence. *Food Quality and Preference*, *71*, 197–208. https://doi.org/10.1016/j.foodqual.2018.07.009

Specifically, we addressed the thesis objectives by first investigating whether the manipulation of the subject shown on packaging imagery influences consumer perception and response. Thus, **Study 1** (p. 57) assesses whether packaging material, the way in which the main product is depicted, and conveying an attribute of the product through images or texts influence sensory and non-sensory expectations and willingness to buy. Aiming to delve deeper into this latter issue, **Study 2** (p. 67) analyses how the image used to convey a specific product attribute (i.e. that a natural yoghurt has been sweetened) influences consumer expectations and willingness to buy, besides exploring the concepts raised by the different images evaluated by means of a word association task.

In turn, **Study 3** (p. 109) adopts a slightly different approach than that of Study 1 in order to analyse the way in which the product is depicted, and investigates how the food shown accompanying the main product in the serving suggestion displayed on the package influences sensory expectations, non-sensory expectations and willingness to buy, besides assessing its effect on the time of day considered most appropriate for consumption. Subsequently, **Study 4** (p. 119) aims to see whether the effects found in the previous studies do not only affect expectations but also perception during tasting. Thus, it is assessed how the visual appearance of the product depicted on the package influences perception during tasting and, based on related literature, the moderating role of gender differences is examined.

Once we had gained deeper insights regarding the effects of packaging imagery on consumer perception and response, we sought to explore the processes by which consumers generate meaning from ambiguous images depicted on food packaging. Thus, **Study 5** (p. 131) investigates the role of the congruence between the product and the image's possible meanings on how the image is interpreted, and also examines the cognitive effort necessary to process it regarding the image rhetorical style (i.e. whether the image interpretation is literal or metaphorical). Finally, we wanted to go one step further into disentangling the mechanism by which packaging imagery is interpreted by analysing the case of pairing an ambiguous image with an ambiguous product. Building on cross-modal correspondence literature, **Study 6** (p. 145) proposes and demonstrates that the shape of the image can be used to convey product information and thus modulate consumer interpretation, thereby affecting expectations. In addition, the underlying mechanism of this process is also investigated. Overall, the thesis objectives were addressed from an interdisciplinary approach by looking at different aspects of how packaging imagery affects consumer perception and response.

2.2. Summary of publications

2.2.1. Study 1 p. 57

Rebollar, R., **Gil, I.**, Lidón, I., Martín, J., Fernández, M. J., & Rivera, S. (2017). How material, visual and verbal cues on packaging influence consumer expectations and willingness to buy: The case of crisps (potato chips) in Spain. *Food Research International*, *99*, 239–246. https://doi.org/10.1016/j.foodres.2017.05.024

Objectives

Although food packaging is composed of different visual cues which all have been suggested to contribute to consumer expectations and response, some of them have been barely studied thus far. For example, it is the case of packaging material and the images depicted on the package. The effect of packaging material on consumer perception has mainly been studied either from a haptic perspective or regarding its ability to convey concepts related to sustainability and naturalness, so that its effect on consumer sensory expectations and response is yet unknown. On the other hand, research regarding packaging imagery primarily accounts for the effects of displaying (or not) an image of the product, although in practice the most usual question that designers face is rather what image of the product should be displayed. Designers commonly have to choose among dozens of images depicting the product contained within the package, yet how the way in which the product is represented influences consumer expectations and response has not been previously studied. Furthermore, designers often have to choose between using an image (i.e. a visual cue) or a text (i.e. a verbal cue) to convey product information to consumers. Even though there is a growing body of literature devoted to understanding the processing differences between images and texts, we still don't know how con-

veying product attributes through visual or verbal cues influences consumer expectations and response.

Thus, this study aims to assess how (1) material, (2) the way in which the product is depicted and (3) conveying product attributes through visual or verbal cues influence consumer sensory expectations, non-sensory expectations and willingness to buy. Specifically, this study addresses the **objectives 1.1.** and **1.2.** of this thesis.

Materials and methods

174 participants conducted a within-subjects online survey divided in two parts in which they had to evaluate six crisps packages of olive oil fried crisps. Stimuli were realistically designed according to the findings of a market study conducted beforehand. Part I addressed the thesis **objective 1.1.** by assessing how packaging material and the way in which the product is depicted influence sensory expectations (i.e. salty, intense flavour, crunchy), non-sensory expectations (i.e. artisan, high quality) and willingness to buy. To that end, four crisps packages were created in which only packaging material (metallized and paper-like) and product image (an image depicting a small pile of loose crisps ready for consumption and an image of the process of transforming uncooked potatoes into crisps) were manipulated. The data corresponding to the attribute expectations and the data corresponding to the willingness to buy were analysed by a 2 (material) x 2 (product image) repeated measures ANOVA and by a multidimensional scaling.

On the other hand, part II addressed the thesis **objective 1.2.** by studying how conveying product attributes through visual or verbal cues influences sensory expectations (i.e. intense flavour, crunchy), non-sensory expectations (i.e. artisan, high quality, healthy) and willingness to buy. Thus, two additional crisps packages were created in which only the way of conveying that the crisps had been fried with olive oil (whether through an image or through a textual claim) was manipulated. Participants' evaluations of both the attribute expectations and the willingness to buy were compared by means of a paired measures t-test.

Results and contributions

This paper contributes to the existing literature by demonstrating that packaging material, the way in which the product is depicted and the way in which product attributes are conveyed (whether through visual or verbal cues) all have an effect on several of the attributes evaluated. The results suggest that an interaction exists between packaging material and product image for some of the attributes, and that in general the effect of the product image is stronger than the effect of packaging material. Whereas the packages with a paper-like material raised higher quality expectations than the metallized packages, crisps bags depicting the crisps ready for consumption elicited higher crispiness and saltiness expectations and higher willingness to buy than the crisps bags depicting the product in process of transforming uncooked potatoes into crisps. Contrarily, showing the product in process rather than ready for consumption raised higher expectations for the attribute artisan (Fig. 1).

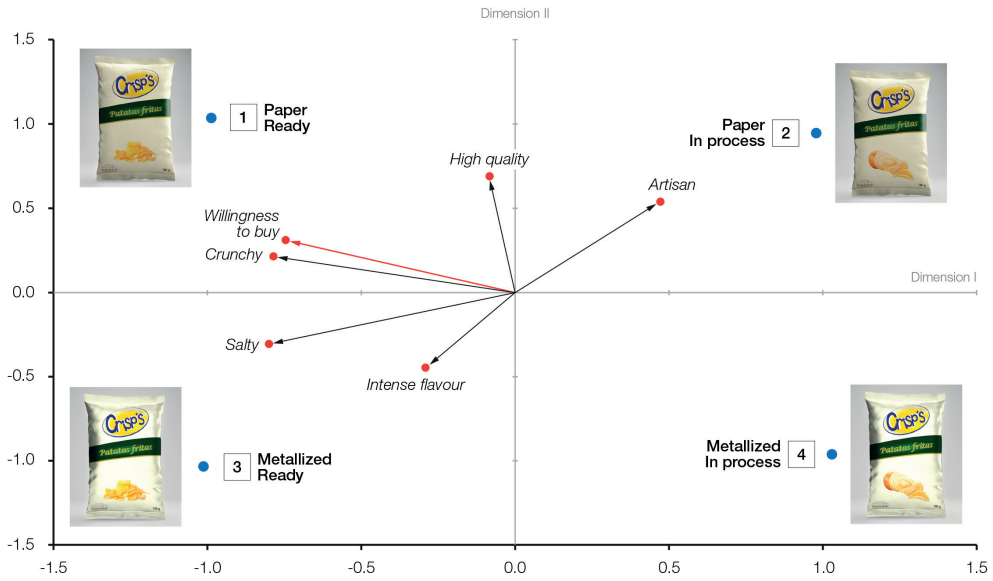

Fig. 1. Results of the multidimensional scaling (Study 1).

Regarding the way in which product attributes are conveyed, results show that communicating that the crisps have been fried with olive oil through an image rather than through a text elicits higher expectations for all the assessed attributes and for willingness to buy (Fig. 2). This finding suggests that visual cues are more effective and attractive than verbal cues when it comes to conveying messages regarded as positive by consumers (such as the crisps being fried with olive oil).

Fig. 2. Stimuli used in part II of Study 1. Conveying that the crisps have been fried with olive oil through an image (left) rather than through a text (right) elicited higher expectations for all the assessed attributes and for willingness to buy.

2.2.2. Study 2 p. 67

Rebollar, R., Lidón, I., **Gil-Pérez, I.**, & Martín, J. (2018). Images used to convey that a natural yogurt is sweetened influence consumer expectations and willingness to buy. *Manuscript submitted for publication to the Journal of Dairy Science*.

Objectives

Given that packaging is a key communication tool, one of the main objectives of packaging imagery is to convey messages to consumers. Typically, these messages aim to inform consumers about relevant product attributes such as its ingredients, its flavour or its texture. In the previous study, we demonstrated that conveying a given product attribute through an image rather than through a text enhanced both expectations and willingness to buy, which highlights the potential of images as communicative devices. However, there are many cases in which the same message can be conveyed through different images, so that designers have to decide which one will be more adequate in terms of both consumer understanding and impact on consumer perception. Take for example the case of sweetened yoghurt: It can be conveyed that the product has been sweetened through images depicting sugar cubes, a spoon with sugar, a sugar sack, and so on. Therefore, the question arises regarding what would be the best one to be displayed on the packaging in terms of consumer comprehension and consumer perception.

Thus, this study delves deeper on the findings of the previous study by analysing how the image shown on the package to communicate that a natural yogurt has been sweetened affects both consumer expectations and willingness to buy. Specifically, this study addresses the **objective 1.1.** of this thesis.

Materials and methods

Four yoghurt packages were created for this experiment, in which the only manipulation was the image by which it was conveyed that the yogurt had been sweetened. Following the conclusions of a market study conducted prior to stimuli design, the images chosen to convey that the yogurt had been sweet-

ened depicted a sugar sack, a sugar spoon or sugar cubes. An additional package displaying no images conveying sweetness was also used as a control stimulus. In all the four packages, a textual claim was displayed with the words "yogur natural azucarado" (sweetened natural yoghurt, in English; Fig. 3).

Fig. 3. Stimuli used in Study 2.

The experiment consisted of two different parts. In the first part, 157 participants carried out a within-subjects online survey in which they had to evaluate the four yoghurt packages by indicating their expectations regarding the yoghurts' sweetness, quality, healthfulness, and content of natural ingredients, and also by pinpointing their willingness to buy. Hence, the thesis **objective 1.1.** was addressed. Both the expectations and willingness to buy data gathered through the online survey were analysed individually using one-way repeated measures ANOVAs and jointly using a multidimensional scaling.

In the second part, 112 participants (other than those who took part in the online survey) conducted a between-subjects word association task in which they were randomly divided in four groups of 28 people. They had to evaluate the yoghurt packages by writing down the first three words, associations, thoughts or feelings that came to their minds. Responses were analysed qualitatively and by means of a HJ Biplot.

Results and contributions

Results show that the image chosen to convey the message that the yogurt is sweetened influences both consumer sensory and non-sensory expectations and that it also affects willingness to buy. Both online survey and word association results demonstrate that the image depicting sugar cubes is more strongly associated with the sugar concept than the other ones, thus making more accessible the concept sweet in consumers' minds and enhancing sweetness expectations. Indeed, the yoghurt depicting sugar cubes also elicited the lower willingness to buy, suggesting that both concepts (sweetness expectations and willingness to buy) are somewhat negatively related (Fig. 4), whereas the yoghurt depicting the sugar sack enhanced naturalness associations (and thereby raised the higher willingness to buy). Interestingly, our findings also show that not depicting an image may be preferable to depicting an inadequate one, since the package conveying that the yoghurt has been sweetened only through text (i.e. without conveying it through an image) elicited more willingness to buy that the package depicting the sugar cubes. Thus, our findings suggest that designers have to find a balance between clearly conveying that the yogurt is sweetened without much emphasizing it due to the negative impact it may exert on willingness to buy.

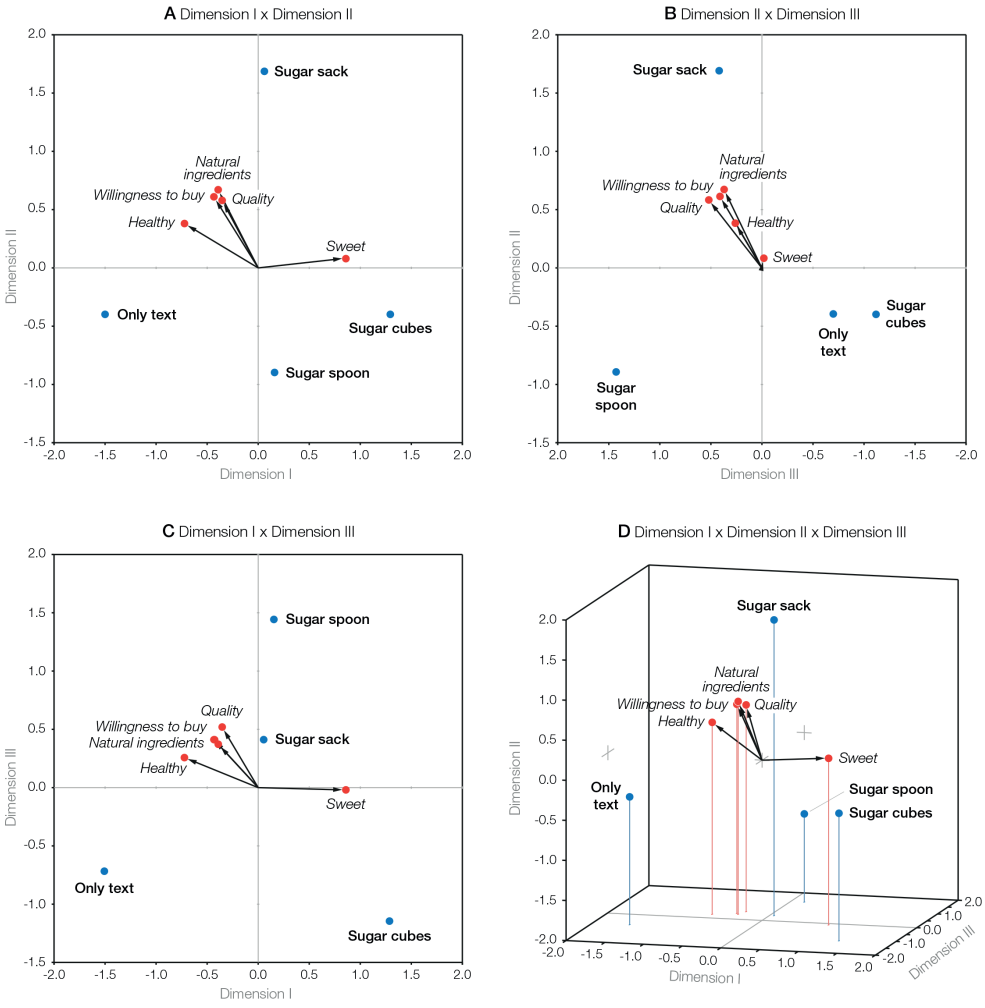

Fig. 4. Results of the multidimensional scaling (Study 2).

2.2.3. Study 3 p. 109

Rebollar, R., Lidón, I., **Gil, I.**, Martín, J., Fernández, M. J., & Riveres, C. E. (2016). The influence the serving suggestion displayed on soft cheese packaging has on consumer expectations and willingness to buy. *Food Quality and Preference*, *52*, 188–194. https://doi.org/10.1016/j.foodqual.2016.04.015

Objectives

Many food packages show an image of the product contained within, although few depict the product in complete isolation. Rather, it used to be depicted together with other products that are not contained within the package in what is known as *serving suggestion*. Through the serving suggestion, designers may convey product sensory characteristics (e.g. tastes or aromas) or consumption information by depicting the product together with other products or elements that suggest the most appropriate way to consume it. However, although it is reasonable to wonder if consumer perception will be influenced depending on the auxiliary products depicted on the serving suggestion, and despite the fact that serving suggestions are fairly used on food packaging, their influence on consumer expectations and willingness to buy has not yet been studied.

This study aims to shed light on this issue by analysing how the products shown accompanying the main product in the serving suggestion displayed on food packaging influence sensory expectations, non-sensory expectations, willingness to buy and the time of day considered more adequate for consumption. Specifically, this study addresses the **objective 1.2.** of this thesis.

Materials and methods

In order to meet the study objectives, five soft cheese packages were designed as stimuli in which the only variant was the serving suggestion (i.e. the products depicted accompanying the soft cheese). The products chosen to be depicted together with the soft cheese were fruit (strawberry and kiwi), quince, salad (lettuce and cherry tomatoes) and sliced turkey, given that a market study conducted beforehand concluded that those are the products most commonly

displayed in soft cheese packages marketed in Spain. In addition, one packaging displaying just the cheese (with no accompanying product) was used as a control (Fig. 5).

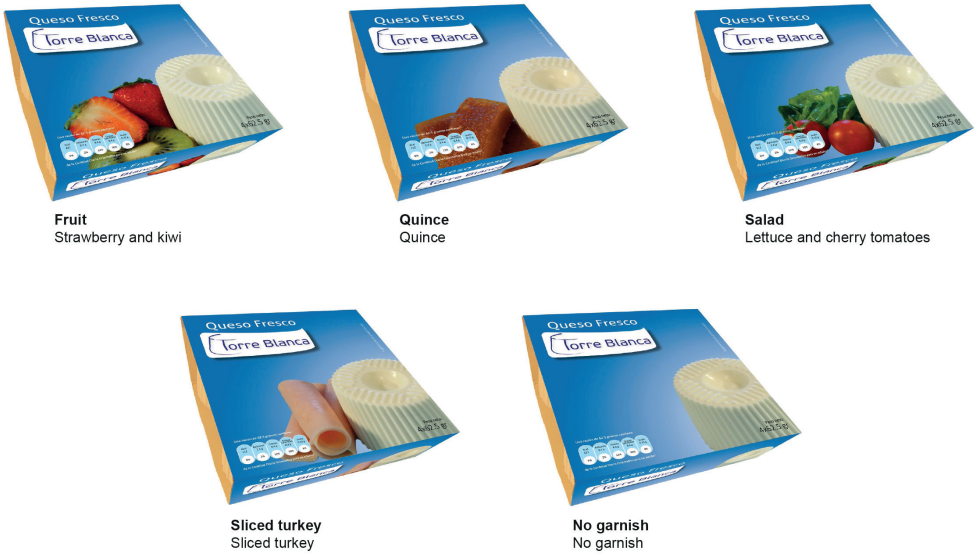

Fig. 5. Stimuli used in Study 3.

247 participants conducted a within-subjects online survey in which they indicated their expectations regarding five sensory attributes (sweet, salty, strong flavour, compact/dense, creamy), three non-sensory attributes (filling, healthy, low-cal), their willingness to buy and five possible consumption times (breakfast, lunch, dinner, in-between meals, at any time) for each of the five soft cheese packages, thus addressing the thesis **objective 1.2**. Both the data corresponding to the product attributes expectations and the data corresponding to the willingness to buy were analysed individually using one-way repeated measures ANOVAs and jointly using a multidimensional scaling. As for the association between time of consumption and stimuli, chi-square in contingency tables and correspondence analysis were used.

Results and contributions

The results indicate that the products depicted accompanying the main product on the serving suggestion do influence consumer expectations and willingness to buy, in addition to shaping consumer beliefs regarding the time of day considered more adequate for consumption. Specifically, results show that consumers tend to project the attributes (or the time of day considered more adequate for consumption) of the products depicted in the serving suggestion into the main product, since for example the soft cheese contained in the package displaying quince was rated as being sweeter that the cheese contained in the package depicting salad (Fig. 6). Given that results also show that sweetness expectations are somewhat negatively related to healthfulness expectations, and that healthfulness expectations are in turn positively correlated to willingness to buy, it can be seen how the packages displaying quince and salad are the ones eliciting respectively less and more willingness to buy. In fact, and according to results from Study 2, it can be seen how the package with no auxiliary products accompanying the cheese in the serving suggestion raises higher willingness to buy than the package depicting quince, highlighting the fact that the positive effect that images are believed to have on consumers' attitudes depends on what is depicted on them.

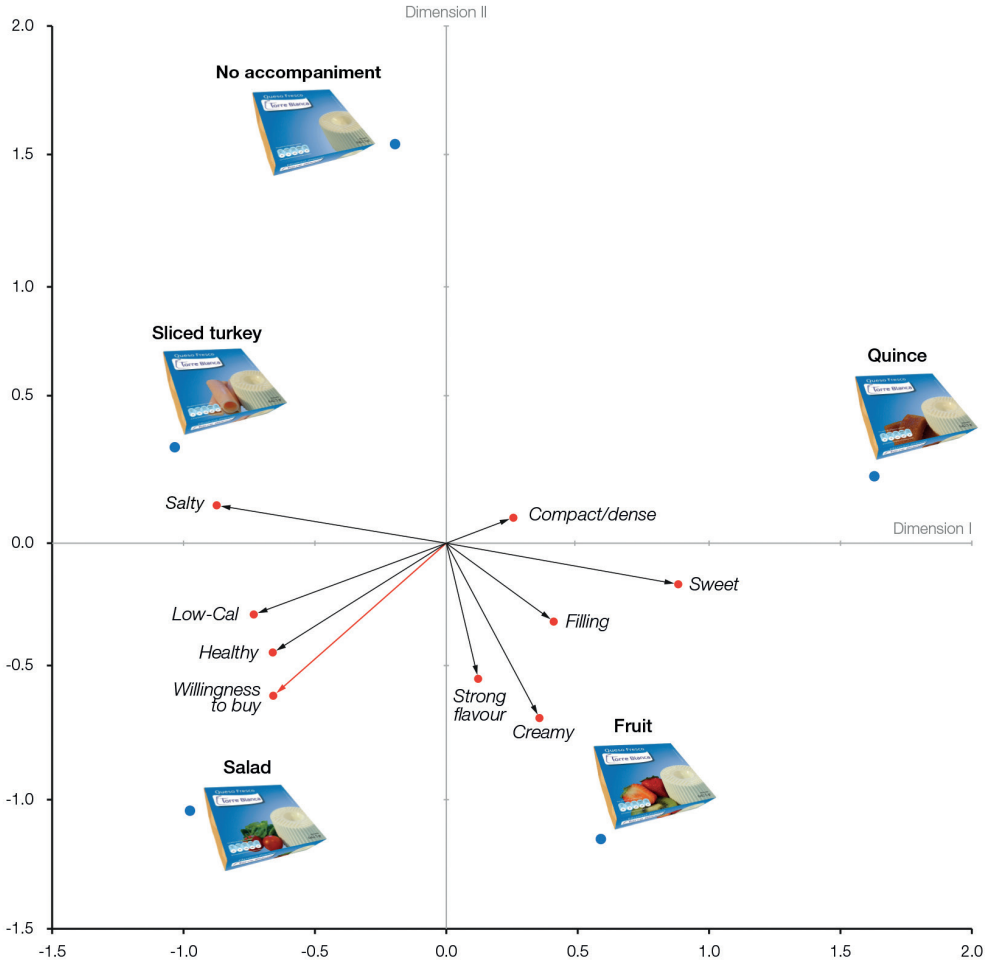

Fig. 6. Results of the multidimensional scaling (Study 3).

2.2.4. Study 4 p. 119

Lidón, I., Rebollar, R., **Gil-Pérez, I.**, Martín, J., & Vicente-Villardón, J. L. (2018). The influence the image of the product shown on food packaging labels has on product perception during tasting: Effects and gender differences. *Packaging Technology and Science*. https://doi.org/10.1002/pts.2407

Objectives

Literature shows that food packaging visual cues may influence not only the expectations raised by the consumer regarding the attributes of the product contained within, but also how the product is perceived during tasting. Visual cues like packaging shape, background colours or even the typefaces used on the label may influence consumer perception, which is relevant for both designers and producers given that it has been suggested that up to a third of food products are consumed directly from their packaging. Yet, and despite being a key element of packaging visual appearance, the influence of packaging imagery on tasting perception has barely been studied.

Studies conducted to date have assessed the effects of manipulating the image's symbolic meaning, congruence or valence, although designers use to rely on congruent and positive-valenced images to design food packaging. Therefore, the question arises regarding what would be the effect of manipulating the visual appearance of the product on consumer perception during tasting. Moreover, it is also reasonable to wonder if the effects would be the same for all consumers, since literature shows that gender differences may exist due to women's greater sensibility both to visual and olfactory stimuli.

Thus, this study aims to assess the influence of manipulating the visual appearance of the product depicted on the package on consumer perception during tasting and to explore if that influence is moderated by gender differences. Specifically, this study addresses the **objective 1.2.** of this thesis.

Materials and methods

147 participants took part in a between-subjects experiment in which they had to taste and evaluate a sample of apple sauce. In order to address the aims of the experiment (i.e. whether the visual appearance of the product depicted on the label affects consumer perception, **objective 1.2.**; and whether that effect is moderated by gender), two apple sauce jars were created in which only the visual appearance of the apple depicted on the label was manipulated (green or red). To enhance the ecological validity of the experiment, several physical copies of each jar were made so that the participants could manipulate them during the tasting (Fig 7). Thus, 74 participants tasted the apple sauce from the jar in which a red apple was shown and 73 participants tasted the sauce from the jar in which a green apple was rather depicted. No differences regarding participant's gender or any other variable were found between the two groups. Participants had to evaluate three sensory attributes (sweet, acidic, intense flavour), three non-sensory attributes (healthy, natural, quality), their liking and their willingness to buy. The data was analysed by means of a MANOVA-biplot (multivariate analysis of variance) for two independent factors.

Fig. 7. Stimuli used in Study 4.

Results and contributions

Results from the MANOVA-biplot show that the visual appearance of the product depicted on the package affects liking, willingness to buy and some of the assessed attributes (Fig. 8). Regarding sensory attributes, men perceived the apple sauce from the jar depicting a red apple as being slightly sweeter than the apple sauce from the jar depicting a green apple, while women evaluated the apple sauce from the jar depicting a green apple as being more acidic than the sauce coming from the jar displaying a red apple. This finding suggests that consumers tend to enhance the perception of the salient attributes of the product depicted on the label, since in Spain the red apple varieties are commonly sweeter than the green ones and the green apple varieties tend to be more acidic than the red ones. In addition, women perceived the apple sauce from the jar depicting a red apple as being healthier and of higher quality than the sauce coming from the green apple jar, in turn liking it more and claiming a higher willingness to buy it. Thus, our findings indicate that gender differences exists given that the reported effects were stronger for women than for men.

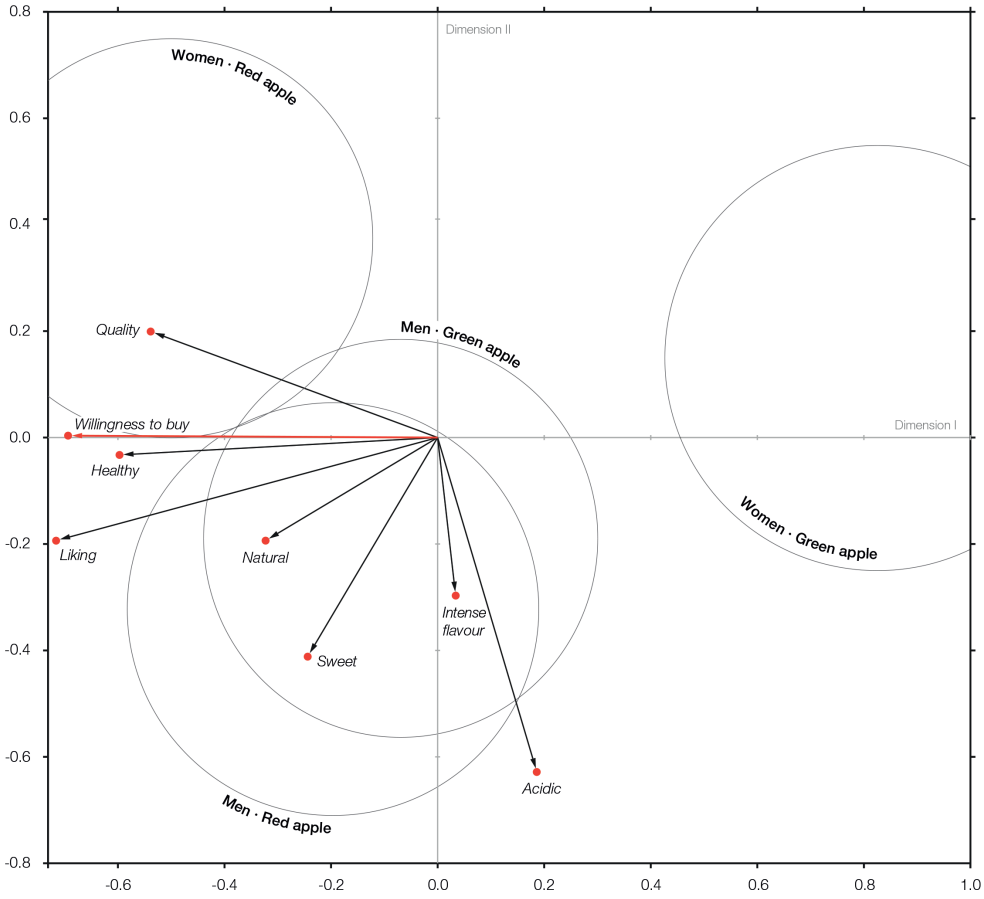

Fig. 8. Canonical representation of the cohort (Study 4).

2.2.5. Study 5 p. 131

Gil-Pérez, I., Rebollar, R., Lidón, I., Piqueras-Fiszman, B., & van Trijp, H. C. M. (2019). What do you mean by hot? Assessing the associations raised by the visual depiction of an image of fire on food packaging. *Food Quality and Preference*, *71*, 384–394. https://doi.org/10.1016/j.foodqual.2018.08.015

Objectives

Consumers rely on packaging imagery to identify and categorise products and to set expectations about their properties. Thus, designers have to anticipate the meaning that consumers will infer from images depicted on food packages in order to convey the desired messages and to avoid confusion. However, it is a challenging aim since images are inherently ambiguous due to their propositional indeterminacy, and therefore can be interpreted in different ways. For example, consider the case of depicting fire on a food package. Although its possible meanings are narrowed due to the context in which it is shown (food packaging), it still remains as an ambiguous cue since it may be interpreted literally (i.e. in the sense that the product has something to do with concepts such as barbecue) or metaphorically (i.e. in the sense that the product is spicy).

This study seeks to understand the factors responsible for consumers inferring a specific meaning from packaging imagery by following the previous example, thus investigating the way an image of fire displayed on a food package influences the associations accessed by the consumer: Specifically, this study aims to assess the effect of congruency between fire image meaning and product category on classification easiness. In addition, it aims to assess how the rhetorical style of the image (i.e. whether its interpretation is literal or metaphorical) affects the cognitive effort necessary to process it. Thus, this study addresses the **objectives 1.1.**, **2.1.** and **2.2.** of this thesis.

Materials and methods

The study was composed of two pretests and a main experiment. Results from the two pretests confirmed that the assumptions on which the main experiment was based were correct, namely that a fire image depicted on a food package

produces either literal or metaphorical meanings related to food (pretest 1) and that a fire image on a food package makes a possible product attribute congruent with the fire image more easily accessible on consumers' minds (pretest 2).

Finally, 65 people participated in the main experiment, which followed a within-subjects design and consisted of two speeded classification tasks and a manipulation check. The speeded classification tasks aimed to analyse the effect of displaying (or not) an image of fire on classifying product categories congruent or incongruent with the meanings of fire, thus addressing the thesis **objectives 1.1.** and **2.1.** (Fig. 9). Hence, one speeded classification task was devoted to the literal meanings of fire (barbecue, roasted) and the other to the metaphorical meaning of fire (spicy). In turn, the manipulation check aimed to verify that the product categories selected as congruent and incongruent for each speeded classification task really were so. Since the manipulation check results showed that the product categories were all adequate, they were all subsequently analysed. As for the data analyses, the effect of congruency between fire image meaning and product category on classification easiness was measured by means of a 2 x 2 repeated measures ANOVA with product category congruency (congruent, incongruent) and fire depiction (with fire, without fire) as the two factors and the mean reaction time (RT) required to classify each product category as the dependent variable.

On the other hand, the effect of fire image rhetorical style on the cognitive effort required to process it was measured by conducting an ANCOVA in which response times needed to classify the congruent products shown with fire from both speeded classification tasks were compared (thus addressing the **objective 2.2.**).

Fig. 9. Examples of the stimuli (salad, tabasco, and skewers, from left to right) without fire (above) and with fire (below) used in Study 5.

Results and contributions

The results from this study show that an interaction exists between the product category (congruent vs. incongruent) and the image (with fire vs. without fire) for both possible meanings of fire (literal, i.e. barbecue, roasted; or metaphorical, i.e. spicy), since products congruent with a meaning of fire were categorised more quickly when showed with fire than without it and products incongruent with a meaning of fire were categorised more slowly when showed with fire than without it (Fig. 10). These results demonstrate that consumers tend to interpret a potentially ambiguous image by relying on the congruence of any of its possible meanings with the possible attributes of the product with which it is displayed, thus highlighting the key role of congruency on the interpretation process. In addition, the results also show that an image with a literal rhetorical style requires a lesser cognitive processing effort than an image with a metaphorical rhetorical style, since stimuli were categorised more easily when the interpretation of fire was literal (e.g. barbecue) than in those that were metaphorical (e.g. spiciness).

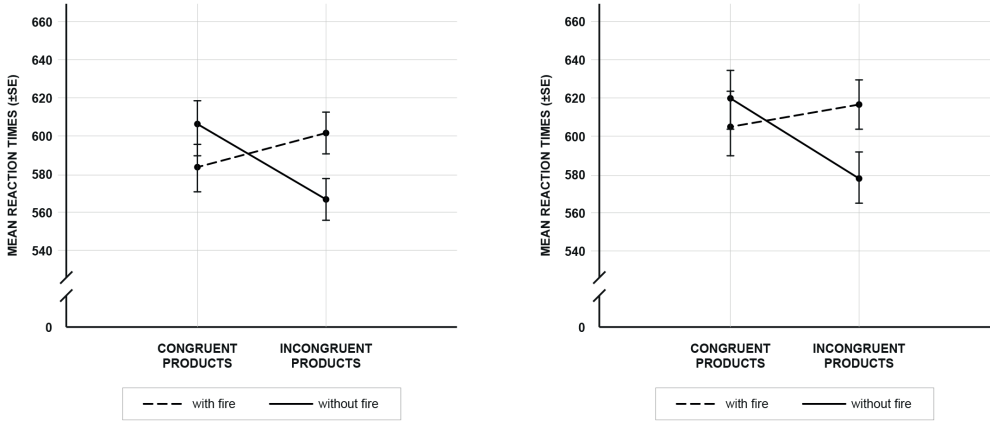

Fig. 10. Mean reaction times in milliseconds as a function of (a) product congruency with the literal meanings of fire (i.e. barbecue, roasted) and the depiction of fire and (b) product congruency with the metaphorical meaning of fire (i.e. spicy) and the depiction of fire (SE=standard error; the error bars indicate 95% confidence intervals; Study 5).

2.2.6. Study 6 p. 145

Gil-Pérez, I., Rebollar, R., Lidón, I., Martín, J., van Trijp, H. C. M., & Piqueras-Fiszman, B. (2019). Hot or not? Conveying sensory information on food packaging through the spiciness-shape correspondence. *Food Quality and Preference*, *71*, 197–208. https://doi.org/10.1016/j.foodqual.2018.07.009

Objectives

When designing food packaging, it is worth noting that not only packaging imagery but also product categories may be inherently ambiguous for consumers. Take for example the case of a bag of nuts: The nuts may be roasted or may be spicy, so the consumer will look for cues in the package that allow him to infer which subcategory the product belongs to. Given that an image of fire is also indeterminate in this context since it may also convey both concepts (roasted and spicy), a package of nuts depicting an image of fire will remain ambiguous. However, as consumers infer information more quickly from images than from texts, specifying the subcategory to which the product belongs through a text does not completely solve the problem since literature suggests that if the interpretation that consumers give to the image contradicts the one elicited by the text, disconfirmation of expectations may follow.

Thus, based on the literature dedicated to cross-modal correspondences, this study aims to assess if consumer expectations may be modulated by manipulating the image's features (namely, its angularity), proposing that a correspondence exists between angular shapes and spiciness. In addition, it aims to analyse the mechanism behind this effect, proposing that the nature of this effect is affective. Specifically, this study addresses the **objectives 1.1.**, **2.1.**, and **2.3.** of this thesis.

Materials and methods

The study was composed of two pretests and a main experiment. After verifying that a fire icon depicted on the front of a bag of nuts is an indeterminate stimulus which can be equally interpreted as being roasted or spicy (pretest 1), eight fire icons varying only in their angularity were designed. 35 people tested the effectiveness of the icons' shape manipulation and demonstrated that the four icons intended to be considered angular really were so, and that the four icons intended to be rather considered rounded also were so (pretest 2). Hence, eight nuts' packages varying only in the fire image depicted on their front were designed (Fig. 11).

Fig. 11. Example of an angular fire icon (left) and a rounded fire icon (right) bag of nuts used in Study 6.

66 participants took part in the main experiment, which followed a within-subjects design study and was composed of three parts. In part I, the association between spiciness and shape angularity was evaluated by means of shape symbolism response scales. In part II, participants were asked to rate the perceived aggressiveness of the fire icons. Finally, in part III participants conducted a speeded classification task in which the effect of the shape angularity of the fire icons on sensory expectations was measured (thus addressing **objectives 1.1.**, **2.1.** and **2.3.**).

As for the data analyses, responses from each shape symbolism scale used in part I were assessed by conducting one-sample t-tests (and were subsequently compared by means of a paired measures t-test). In turn, data from the speeded classification task was first analysed in a 2 × 2 repeated measures ANOVA with the shape of the fire icons (angular, rounded) and expectations (spicy, roasted) as the two factors and the mean reaction time (RT) required to classify each nuts bag as the dependent variable. Once an interaction between both factors

was found, the implicit sensory associations for each set of fire icons (angular or rounded) was operationalized as Cohen's d_z standardized difference scores. Finally, a mediation analysis was conducted to investigate whether the effect of the icons' shape on sensory expectations was mediated by the perceived aggressiveness of the icons.

Results and contributions

Results from this study show that consumers tend to associate spiciness with angular shapes, and that this correspondence can be used to modulate consumer expectations by manipulating the shape of an image. In fact, participants were faster categorising the nuts' bags depicting pointy fire icons as being spicy than as being roasted, while the opposite was true for the nuts' bags displaying rounded fire icons. In addition, results from the mediation analysis indicate that this effect can be explained in terms of an affective mediation, since the icons' perceived aggressiveness mediated the effect of shape angularity on sensory expectations: Specifically, results show that the angular fire icons are perceived as being more aggressive that the rounded fire icons, which in turn enhances spiciness expectations (rather than roasted flavour expectations; Fig. 12). These findings thus show a way by which designers can modulate sensory expectations through manipulating the image depicted on the packaging, thus facilitating the ability to better convey desired messages to consumers.

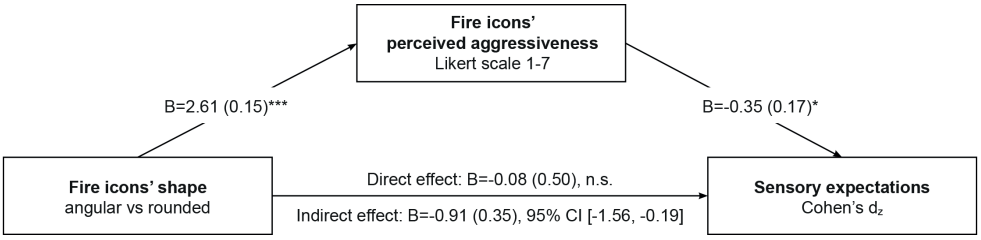

Fig. 12. Mediation analysis conducted in Study 6 (MEMORE 1.1, number of bootstraps=5000). Note: Negative values in the dependent variable represent a stronger association with spiciness rather than with roasted flavour, while the opposite is true for positive values. Coding=angular (1), rounded (0); B (SE)=path coefficient (standard error); *p < 0.05, **p < 0.01, ***p < 0.001.

3. PUBLICATIONS

3.1. Study 1

Rebollar, R., **Gil, I.**, Lidón, I., Martín, J., Fernández, M. J., & Rivera, S. (2017). How material, visual and verbal cues on packaging influence consumer expectations and willingness to buy: The case of crisps (potato chips) in Spain. *Food Research International*, *99*, 239–246. https://doi.org/10.1016/j.foodres.2017.05.024

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How material, visual and verbal cues on packaging influence consumer expectations and willingness to buy: The case of crisps (potato chips) in Spain

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ABSTRACT

This paper analyses the influence that certain aspects of packaging design have on the consumer expectations of a series of sensory and non-sensory attributes and on willingness to buy for a bag of crisps in Spain. A two-part experiment was conducted in which 174 people evaluated the attributes for different stimuli using an online survey. In the first part, four stimuli were created in which two factors were varied: the packaging material and the image displayed. Interaction was identified between both factors for the attributes *Crunchy*, *High quality* and *Artisan*. For the attributes *Salty*, *Crunchy* and *Willingness to buy*, the image was the only significant factor, with the image displaying crisps ready for consumption being the only one that obtained higher scores. For the attribute *Intense flavour*, no statistically significant differences were identified among the stimuli. In general terms, the image displayed on the bag had a greater influence than the material from which the bag was made. In the second part, an analysis was made of the most effective way (visual cues versus verbal cues) to transmit the information that the crisps were fried in olive oil. To this end, two stimuli were designed: one displaying an image of an oil cruet and another with an allusive text. For all the attributes (*Intense flavour, Crunchy, Artisan, High quality, Healthy* and *Willingness to buy*), higher scores were obtained with the image than with the text. These results have important implications for crisps producers, marketers and packaging designers.

1. Introduction

During the process of designing a food package, the designer must make many decisions about the package's visual appearance. Studies conducted in recent years show that each of these decisions can influence the consumer's expectations of the product and their willingness to buy it, both individually and through interactions with other decisions made (Becker, van Rompay, Schifferstein, & Galetzka, 2011; Piqueras-Fiszman & Spence, 2011; Piqueras-Fiszman, Velasco, & Spence, 2012; Rebollar, Lidón, Serrano, Martín, & Fernández, 2012; Sundar & Noseworthy, 2014). Consumers' expectations are generated from their beliefs and their prior experiences as well as from a product's extrinsic aspects, such as the packaging's characteristics (see Deliza & MacFie, 1996; Piqueras-Fiszman & Spence, 2015 for reviews). In this context, the visual appearance of a product's packaging has an important role in generating consumer expectations and also modulates willingness to buy (see Deliza & MacFie, 1996; Piqueras-Fiszman & Spence, 2015 for reviews). Designers now have a great deal of useful information to consider when designing packaging; however, this information is far from being complete and there are still some aspects of the visual appearance of packaging that remain largely unstudied. This is true for packaging material, the product image displayed on the front of the package and the relationship between visual and verbal cues.

Material is considered to be one of the elements that forms a part of the visual appearance of a packaging (Magnier & Schoormans, 2015). Studies thus far have observed that, just as other visually processed design elements, material has a capacity to influence the way in which consumers perceive the product and the ideas that they generate about its characteristics (Mutsikiwa & Marumbwa, 2013). However, in the field of perception, packaging material has been mainly studied from a perspective of haptic perception (i.e. information acquired through the hands) (Biggs, Juravle, & Spence, 2016; Chen, Barnes, Childs, Henson, & Shao, 2009; Krishna & Morrin, 2008; Piqueras-Fiszman & Spence, 2012; Schifferstein, Fenko, Desmet, Labbe, & Martin, 2013; Tu, Yang, & Ma, 2015), and the sensory transfer between touch and flavour (Spence, 2016). This body of

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knowledge suggests that packaging material may play a role in the generation of sensory expectations and willingness to buy, although this relationship has not been studied thus far. In this context, research conducted so far has mainly focused on the concepts of sustainability and naturalness. Labbe, Pineau, and Martin (2013) observed that touch and sight are the predominant senses used to evaluate the naturalness of a package of dehydrated soup, in a study that compared the use of different kinds of materials in a packaging. Magnier and Schoormans (2015) found that using a sustainable material positively influences the perceived ethicality of the brand and increases willingness to buy, particularly when the sustainability is visibly showcased. In an earlier study, the same researchers found that consumers perceived a package of raisins made from recycled cardboard to be more sustainable than one made from white plastic (Magnier, Schoormans, & Mugge, 2016).

The product image displayed on the front of a large proportion of food packages is another key element in its visual appearance (Ampuero & Vila, 2006; Liao, Corsi, Chrysochou, & Lockshin, 2015; Rebollar, Lidón, Martín, & Puebla, 2015). It is also one of the graphic elements that gives graphic designers most possibilities in terms of aesthetics as well as communication, and it tends to occupy an important space in the composition. For consumers, it is particularly important since it lets them know about the visual aspect of the product before buying it, making it a key element in the creation of expectations (Jaeger & MacFie, 2001; Underwood & Klein, 2002). The consumer's response depends on the characteristics of the image as well as whether it is an illustration or a photography (Deliza, Macfie, & Hedderley, 2003; Smith, Barratt, & Selsøe Sørensen, 2015), its size (Neyens, Aerts, & Smits, 2015), the quantity of product units displayed (Madzharov & Block, 2010) and the product used as a serving suggestion (Rebollar et al., 2016). However, in practice the designer very frequently chooses from a selection of different images of the product in which the main variation is the way in which it is represented (e.g. cut or whole, raw or ready for consumption). Few studies have used the way in which the product is represented in the image as a design variable (Kobayashi & de Benassi, 2015; Machiels & Karnal, 2016), although it seems reasonable to think that the different ways of representing the product will generate different responses in the consumer in terms of their sensory and non-sensory expectations and willingness to buy. However, this effect is yet to be further studied.

Moreover, while designing a packaging, the designer may use verbal or visual cues to communicate a message or an idea (Kauppinen-Räisänen, Owusu, & Abeeku Bamfo, 2012; Machiels & Karnal, 2016). The benefits of opting to use one over the other have been studied earlier in the fields of advertising and preventive medicine (Hammond et al., 2007; Jaeger & MacFie, 2001; Maynard, Munafò, & Leonards, 2013; Phillips, 2000; Rayner, Rotello, Stewart, Keir, & Duffy, 2001; van Rompay- & Veltkamp, 2014). Visual and verbal cues produce different consumer responses and require different levels of cognitive processing (Kauppinen-Räisänen et al., 2012). Studies conducted thus far demonstrate that visual cues produce a higher vividness effect and require a type of unconscious and unintentional processing, while verbal cues require a higher level of cognitive effort (Mueller, Lockshin, & Louviere, 2009; Underwood & Klein, 2002). Visual cues attract the consumer's attention at point of sale (Honea & Horsky, 2012; Silayoi & Speece, 2007; Venter, van der Merwe, de Beer, Kempen, & Bosman, 2011) and their use enables consumers to generate expectations more quickly than through reading a text (Underwood & Klein, 2002). Nevertheless, designers should not underestimate the impact of transmitting information through verbal cues (Machiels & Karnal, 2016; Orth & Marchi, 2007). The influence of text and words on the way in which a food product is perceived and experienced has attracted great interest (Okamoto et al., 2009; Spence & Piqueras-Fiszman, 2014; Yeomans, Chambers, Blumenthal,- & Blake, 2008), and it has been found that expectations generated by a product depend largely on the textual information displayed (Grabenhorst, Rolls, & Bilderbeck, 2008; Lähteenmäki et al., 2010; Liem, Toraman Aydin, & Zandstra, 2012; Siret & Issanchou, 2000; Sütterlin & Siegrist, 2015). However, it is not easy for a designer to apply this knowledge. The real problems designers face are very complex: often they have to communicate several messages in different hierarchies through one product packaging. In the case of a bag of crisps fried in olive oil, the designer must communicate the main message (crisps) and also a secondary one (with olive oil). Both messages can be communicated through visual cues, verbal cues, or through a combination of both. On commercial packaging, in most cases the main message (crisps) is communicated through both visual cues (an image of crisps) as well as verbal cues (the word “crisps”). However, it is not clear which is the most effective way to communicate the secondary message (that they have been prepared with olive oil). It is not easy to know the impact this decision will have on consumer expectations and willingness to buy, and the simultaneous nature of the stimuli means extracting valid conclusions from the studies conducted thus far is a complex task.

Owing to all the above, we expect that the modification of any of these three factors (i.e. the packaging material, the product image displayed or the use of visual or verbal cues to communicate additional information) will produce an effect on the consumer's sensory and non-sensory expectations as well as on willingness to buy. In summary, the specific aims of the present study were to analyse how the following factors of a bag of crisps: 1) the packaging material; 2) the way in which the product is represented in the image displayed on the packaging; and 3) the use of visual or verbal cues to communicate additional product information; affect consumer expectation for certain sensory and non-sensory attributes and the willingness to buy the product.

2. Materials and methods

2.1. Participants

One hundred and eighty-two persons participated in this investigation; eight of these were excluded because they did not complete the survey and were not included in the results. As such, one hundred and seventy four (approximately 51% female and 49% male, 18–61 years old, mean age of 27.6 (± 12.3) years) participants were considered.

With regard to their educational profile, approximately 64% of participants stated they had university qualifications, 35% stated they had qualifications from non-university institutions, and 1% said they had no professional qualifications.

With respect to the consumption of crisps, 13.8% stated they consumed them frequently (at least once a week), 64.9% answered from time to time (at least once a month), 20.1% said that they rarely ate them (less than once a month), and the remaining 1.1% admitted never having consumed crisps.

2.2. Procedure

The experiment was conducted via social media on a voluntary and anonymous basis, using an online survey tool to gather the data: SurveyMonkey®. Participants were not set a time limit to complete the survey or any particular section thereof. They were shown photorealistic renderings of six (4 in the first part and 2 in the second one) different crisps packages created for this investigation and given a survey to evaluate them. These stimuli were created using Photoshop CS5 (Adobe Systems Inc., San Jose, CA, U.S.A.) and Keyshot 4 (Luxion Inc., Tustin, CA, U.S.A.). All participants viewed the same packages displayed sequentially in a random order, so a within-subject experimental design was used.

2.3. Stimuli

A market study was carried out prior to the design of the stimuli to know the most frequent characteristics of the packages of potato chips sold in the Spanish market. The experiment was conducted in two separate parts.

Fig. 1. Visual stimuli used in part I of the investigation.

In part I, four crisps packages were designed in which only two factors were modified: the packaging material (*Material*) and the main image shown on it (*Image*) in order to evaluate the contribution of these two design factors to consumer expectations about sensory and non-sensory attributes and willingness to buy (see Fig. 1 and Table 1). For the material finish, it was decided to use two levels: one bag had a matt finish and the other had a shiny metallic finish. From now on these two levels will be simplified as "Paper" and "Metallized" respectively. Likewise, two levels were also used for the main image. On the first, a small pile of loose crisps was shown ready for consumption. On the second, there was a picture showing the process of transforming uncooked potatoes into crisps. From now on these two levels will be simplified as "Ready" and "In Process". Both methods of representation are frequently used by commercial brands on the Spanish market.

In part II of the experiment, two packages of crisps (see Fig. 2) were prepared to study the effect of the use of visual or verbal cues to communicate the additional information that they were fried in olive oil. The decision was made to design a pack of crisps using the image of an oil cruet as a part of the main image and another one including the text "with olive oil". From now on these two levels will be simplified as "Visual" and "Verbal". On both designs "Paper" material was used since it is the most frequently used in the packages of crisps in olive oil that are sold in Spain. A manipulation check was conducted in order to make sure that both stimuli had the same semantic meaning for Spanish consumers. Participants (N = 17, 19–59 years old, mean age of 31.1, sd = 10.03) were asked, with an open-ended question, to say what kind of crisps they thought were contained in the package that corresponded with the "Visual" stimuli. All participants said that the crisps had been fried or prepared with olive oil, confirming that for Spanish consumers both packages had the same semantic meaning.

The other elements on the packaging were identical in the six packages designed. The package shape was inspired by one of the most typical structures of real packages of crisps, the rectangular, 180 g flexible package. The sizes of the images used in both alternatives of the factor Image were similar. The image elements included the product description (the words "Patatas fritas", crisps in Spanish), the brand

Table 1
List of product attributes used in the experiment.

Product attributes		Willingness to buy
Sensory	Non-sensory	
Salty[a]	*Artisan*	*Willingness to buy*
Intense flavour	*High quality*	
Crunchy	*Healthy*[b]	

[a] Only used in Part I.
[b] Only used in Part II.

Fig. 2. Visual stimuli used in part II of the investigation.

Crisp's (created especially for this investigation so that the participants could not deduce certain attributes of the products based on prior experiences with other brands), the nutritional information (identical on all packages) and the quantity of product contained (identical in all cases).

2.4. Measurements

The survey was divided into three sections: questions to characterize the participants (age, gender, education, and frequency of consumption), a survey to evaluate the packagings in part I of the experiment — stimuli in Fig. 1 — and a survey to evaluate the packagings in part II of the experiment — stimuli in Fig. 2. Table 1 shows the attributes used in the experiment.

For each package, a survey evaluated five attributes and the willingness to buy it. The attributes were chosen by a panel of experts, comprising three packaging designers and three manufacturers from the food industry. They were recruited from the city of Zaragoza where the study was conducted.

In part II of the experiment, the attribute *Healthy* was included and the attribute *Salty* was eliminated, since the panel of experts deemed this to fit in better with the objectives of this part of the experiment.

Participants were asked to evaluate the product attributes for each package according to a LIKERT scale of 1 (totally disagree) to 7 (totally agree). Participants were given the option of leaving the questionnaire blank for questions they did not know how to answer.

Willingness to buy was evaluated using the same scale of 1 (would not buy under any circumstances) to 7 (would be totally willing to buy).

Table 2
Results from linear mixed model. (F: F-value, M: Material; I: Image; df: degrees of freedom; $\hat{\tau}^2$: Between-subject variance; $\hat{\sigma}^2$: Variance of error).

Attributes	$\hat{\sigma}^2$	$\hat{\tau}^2$	F_M (df = 1;519)	*p*-value	F_I (df = 1;519)	*p*-value	F_{MxI} (df = 1;519)	*p*-Value
Salty	1.08	1.20	0.900	0.343	6.522	0.011	0.261	0.601
Intense flavour	0.91	1.28	0.040	0.843	0.014	0.905	0.128	0.721
Crunchy	1.04	1.55	1.320	0.249	19.597	< 0.001	3.057	0.081
Artisan	1.38	1.69	4.010	0.046	3.038	0.082	4.005	0.046
High quality	1.12	1.49	6.654	0.010	0.252	0.616	4.318	0.038
Willingness to buy	0.89	1.81	2.325	0.128	16.099	< 0.001	2.086	0.149

It was specified in the survey that all the products contained the same quantity of crisps and had the same price.

2.5. Data analysis

A linear mixed model (Verbeke & Molenberghs, 2009) was conducted to analyse whether there would be differences between the fixed factors: Material, Image and the interaction between both factors. The subjects (participants) were included in the model as a random factor. This analysis design was chosen because as the four crisp packages were assessed by each subject, these measurements are likely to be highly correlated for any individual participant. When interaction is observed between the two factors, the interpretation of the main effects is compromised since the impact of one factor depends on the level of the other factor. The levels of the factors were therefore concatenated to analyse the interaction and a linear mixed model was conducted with a fixed factor (Material x Image) and a random factor (subjects). The Bonferroni correction was also used. The second part of the experiment was analysed using a dependent *t*-test for paired samples. The significance level chosen was 0.05.

To study the preference of individuals with respect to the packages used in the first part of the experiment (*Material* factor and *Image* factor), the Individual Differences Model was used (Carroll & Chang, 1970; Horan, 1969). This technique is included within multi-dimensional scaling techniques and is also known as INDSCAL. In this study, a matrix (4 × 5) of similarities between packages was calculated for each individual. These similarities were obtained from each individual score given to the different packages of crisps in relation to its sensory and non-sensory attributes. This technique allows the creation of a space of consensus for the individuals showing the similarities between the packages of crisps. In addition, it is possible to find out the weighting that each individual gave to the dimensions obtained in the consensus space. The weightings reflect the importance that the individuals associate to the dimensions in the stimuli space. Although one person can perceive one of the dimensions to be more important than the other, another person can have the opposite perception.

This technique was used with the attributes (sensory and non-sensory), as well as with willingness to buy. The analysis was conducted using the PROXCAL algorithm (Leeuw & Heiser, 1980), and Euclidian distance was used as a measure of similarity. The criterion to choose the number of dimensions in the consensus space was based on goodness of fit and the number of stimuli included in the analysis. S-Stress was used to determine goodness of fit. If this measurement is low, it indicates that the configuration obtained in the map (or space) is good. Although there is no strict rule regarding how much stress is tolerable, the rule of thumb is that a value ≤ 0.1 is good and anything ≥ 0.15 is not tolerable (Kruskal & Wish, 1984).

The vector model (Schiffman, Reynolds, & Young, 1981) was used to interpret the dimensions of preference in accordance with the observable attributes. This procedure uses the multiple regression technique to determine the direction of the attributes. The means of the individual scores of attributes are used to calculate the multiple regression, and the standardized regression coefficients (β_1, β_2) are computed and drawn as coordinates in the two-dimensional stimulus plane. Finally, a line is drawn through the origin of the stimulus consensus space and through coordinates defined by the regression coefficients.

This model allowed the packages to be ordered according to each of the attributes evaluated by the subjects. It also made it possible to determine which attributes had a high correlation in the stimuli evaluation. The data was processed and analysed using SPSS Statistics 23 (Armonk, NY, U.S.A.).

3. Results

3.1. Part I: effect(s) of package material and image

Part I of the experiment studied the influence of two factors, the bag's material and the image of the product displayed on the bag, on a series of sensory and non-sensory attributes and on willingness to buy the product.

Statistically significant differences were obtained for five of the six attributes studied (Table 2). The attribute *Intense flavour* was the only attribute that was not statistically significant for any effect. The attributes *Salty, Crunchy* and *Willingness to buy* were only statistically significant for the factor Image, the difference in means between "Ready" and "In Process" were 0.201 (SE = 0.089), 0.341 (SE = 0.08) and 0.287 (SE = 0.085) respectively.

The rest of the attributes — *Artisan* and *High quality* — showed a statistically significant interaction among the factors. As this interaction was observed, the levels of both factors were concatenated. The results of the multiple comparison analysis for each attribute can be seen in Table 3. Significant differences were identified for the attributes *Artisan* and *High quality,* between 1 ("Paper"-"Ready") and 3 ("Metallized"-"Ready").

The consensus plane obtained by analysing individual differences (Fig. 3) shows similarities among the stimuli. The dimensionality chosen for the multidimensional scaling solution was two dimensions (S-Stress = 0.05). Dimension I differentiates the packages with different images. Dimension II differentiates the packages with different materials. An analysis of the layout of the packages in relation to the attributes included using the vectorial model shows that the attributes *Salty, Crunchy* and *Willingness to buy* are closely associated with Dimension I but are much less related to Dimension II. The attribute *Artisan* is equally associated with both dimensions. *High quality* is

Table 3
Multiple comparisons based on the concatenation of factors (Material and Image). P-R: Paper-Ready; P-IP: Paper-In Process; Mt-R: Metallized-Ready; Mt-IP: Metallized-in Process; DM: difference of means; SE: Standard Error.

		Artisan			*High quality*		
		DM	SE	*p*-value	DM	SE	*p*-value
P-R	P-IP	0.023	0.119	1.000	0.207	0.115	0.412
	Mt-R	0.356	0.114	0.029	0.374	0.104	0.006
	Mt-IP	0.023	0.130	1.000	0.247	0.117	0.179
P-IP	Mt-R	0.333	0.130	0.05	0.167	0.118	0.854
	Mt-IP	0.000	0.113	1.000	0.040	0.106	1.000
Mt-R	Mt-IP	− 0.333	0.146	0.05	− 0.126	0.118	0,174

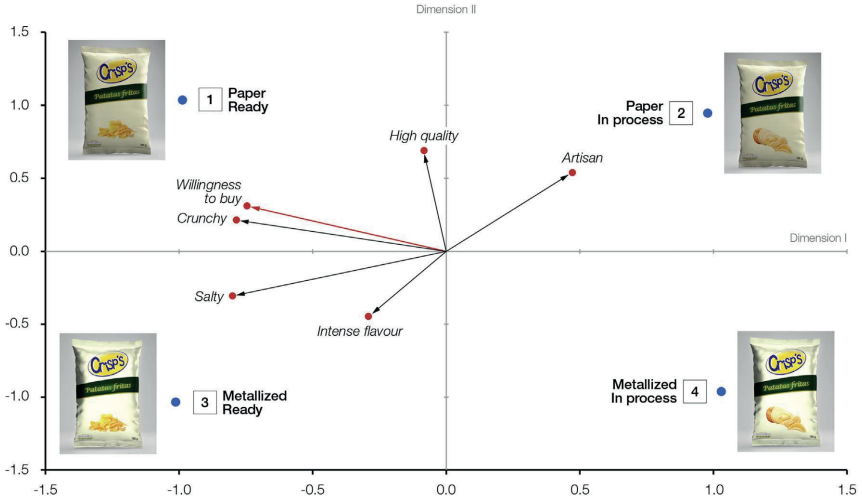

Fig. 3. Two dimensional consensus space for the stimuli (crisps packages).

mainly associated with Dimension II, although this association is non-significant, and *Intense flavour* displays weak associations with both dimensions.

It can be seen how *Willingness to buy* has a strong positive relationship with the attribute *Crunchy*.

The attribute *High quality* displays a weaker relationship with *Willingness to buy* although this result must be interpreted with caution as the association of the attribute *High quality* with the two factors on the plane was not statistically significant.

The analysis of subjects' weightings in each dimension shows that 20% of individuals gave more importance to Dimension I, and only 7% gave more importance to Dimension II. Most subjects (73%) gave similar weightings to each dimension.

3.2. Part II: effect(s) of package additional information

With reference to part II of this experiment, which seeks to investigate how users' perception is influenced by the crisps being fried in olive oil — either by means of the image of an oil cruet ("Visual") or by a text ("Verbal") — the data were analysed by comparing the paired differences between the mean scores of the attributes when the image or the text was presented by means of a *t*-test (Table 4). As can be seen, all the attributes obtained a higher score for the "Visual" stimuli than for the "Verbal" stimuli.

Table 4
t-Test for paired data of the difference between "Visual" and "Verbal".

Attributes	Difference of means "Visual" – "Verbal"	Sample size	*t*-Test	*p*-Value
Crunchy	0.247	174	3.060	0.002
Artisan	0.656	174	6.422	< 0.001
High quality	0.506	174	4.910	< 0.001
Intense flavour	0.437	174	4.804	< 0.001
Healthy	0.437	174	4.460	< 0.001
Willingness to buy	0.529	174	5.216	< 0.001

4. Discussion

This investigation had the aim of studying the way in which the product is represented on the packaging image, the effectiveness of the use of either visual or verbal cues to transmit a secondary message, and how the packaging material affects consumer expectations of the product and their willingness to buy. A bag of crisps was used and the results show that the three design factors studied — Material, Image and the way Additional Information is presented — all have an effect on some of the attributes evaluated.

4.1. Part I: effect(s) of package material and image

The aim of the first part of the experiment was to analyse the effect of factors Image ("Ready", "In Process") and Material ("Paper", "Metallized") on the evaluation of some sensory and non-sensory attributes and on *Willingness to buy*. The results of the ANOVA conducted show that there is an interaction between the Image and Material factors for some of the attributes evaluated, which is consistent with the idea of Orth and Malkewitz (2008) that consumers evaluate packaging holistically and not as the sum of the characteristics of each of its elements. In the cases where there is no interaction, the attributes *Salty* and *Crunchy* and the *Willingness to buy*, the effect of factor Image is stronger than that of Material since the differences between the evaluation of the levels "Paper" and "Metallized" are not statistically significant.

With regard to the factor Image, the "Ready" image obtained higher scores than the "In Process" image for both the attributes *Salty* and *Crunchy* as well as for *Willingness to buy*. These results can be explained by the fact that the consumer uses the appearance of the product to infer its sensory attributes (Jaeger & MacFie, 2001). Therefore, displaying an image of crisps in their final state and ready for consumption allows the consumer to process their sensory characteristics more clearly than if the crisps are shown next to half of an uncooked potato. In addition, when the presentation of a target coincides with the consumer's mental representation of that target, processing fluency is lower, which leads to more positive evaluations (Chae & Hoegg, 2013). In this context, the crisps used for the "Ready" image are probably more similar to the consumer's mental representation of a crisp than the

image used for the "In Process" image. Regarding the attribute *Crunchy*, these results are also congruent with the visual preview model used in cognitive psychology (Klatzky, Lederman, & Matula, 1993). According to this model, viewing an object allows the observer to infer its haptic properties (Klatzky et al., 1993; Peck & Childers, 2003), which is very useful when assessing the crunchiness of a food (de Liz Pocztaruk et al., 2011; Duizer, 2001; Zampini & Spence, 2004). Thus the "Ready" image allows the consumer to more clearly infer the properties of the crisps because this image only shows crisps ready for consumption, which are crunchier than the uncooked potato slices shown in the "In Process" image. Furthermore, some studies suggest that viewing images of food increases hunger and salivation and that this, in turn, increases willingness to buy (Simmonds & Spence, 2016). However, there is an interaction between the Image and Material factors for the attributes *Artisan* and *High quality*, meaning their respective effects cannot be isolated.

The results of the MDS also help to understand the effects of factors Image and Material in those cases in which there is interaction. Thus it can be seen how the "In Process" image is closely related with the attribute *Artisan*, which may be owing to the fact that the image metaphorically shows the process of preparing crisps. The negative relationship between *Willingness to buy* and the attribute *Artisan* may possibly be owing to the higher price that traditionally prepared crisps tend to have on the market. With respect to factor Material, the MDS shows that the visual aspect of the packaging material has an effect on the evaluation of the *High quality* attribute. Magnier et al. (2016) showed that the material used for a food packaging can affect the way that consumers evaluate its sustainability, and can also affect their evaluation of intrinsic product attributes, such as quality. Therefore, packaging with a paper appearance may seem to be of a higher quality than packaging with a metallic aspect. Thus the consumer may subconsciously project the evaluation of that attribute onto the product itself due to the halo effect (Nisbett & Wilson, 1977), which helps to explain why the "Paper" packaging scores were higher for the *High quality* attribute. Nevertheless, the cause for this association between "Paper" and *High quality* is not clear. It is possible that this association exists because the consumer deems that the material is intrinsically higher quality than the "Metallized" material. Another possible explanation may be found in the code established in this market, since, as we observed in the market analysis prior to this study, crisps sold in packaging with a paper-like appearance tend to be more expensive than those sold in metallized packaging.

4.2. Part II: effect(s) of package additional information

In the second part of the experiment, the effect of the additional information factor ("Visual" – "Verbal") was analysed in the evaluation of some sensory and non-sensory attributes and on *Willingness to buy*. The packaging corresponding to the "Visual" level (the one displaying the image of an oil cruet) obtained higher scores for all the attributes evaluated than the packaging corresponding to the "Verbal" level (in which the text "with olive oil" was displayed). These results are consistent with earlier studies that observed that visual information is believe to be more powerful than verbal information (McQuarrie & Mick, 2003; McQuarrie & Phillips, 2005). In this context, Sehrawet and Kundu (2007) demonstrated that for a low-involvement product, such as a bag of crisps, the use of visual cues allows the transmission of information in less time and with less effort than verbal cues because of the effort involved in processing a text. This lower processing fluency could therefore favor greater acceptance of the product (Chae & Hoegg, 2013). From an attention perspective, it is even possible that there are people who have not paid attention to the text. According to the findings of Rebollar et al. (2015), the larger relative size of the image of the potatoes with respect to the text on the packaging corresponding to the "Verbal" stimulus may have led to this cue having attracted the attention of the consumer, meaning that the text may have gone unnoticed. Despite this possible effect, the relative difference of sizes between the image of the crisps and the text was maintained to guarantee the realism of the stimuli and therefore be able to extrapolate these results to a realistic design case study.

It is important to underscore that the two packages corresponding to the additional information factor already display a visual cue (the product image). Our results indicate that, if together with that cue, the aim is to communicate the secondary message that the product has been prepared with olive oil, which is of interest for the consumer (López-Miranda et al., 2010), doing this through "Verbal" cues may not be a good idea because the stronger impact of the product image means that the textual message goes unnoticed. However, by communicating this message through an image, the consumer processes the message more quickly in its entirety by perceiving it as a single visual cue. This kind of crisp may be considered to be superior to standard ones, as such a higher evaluation of all the attributes studied may be expected (*Intense flavour, Crunchy, Artisan, High quality, Healthy* and *Willingness to buy*). This was true in both cases, with the scores where the image was displayed being higher than those where the text was displayed.

4.3. Limitations and future research

With respect to the stimuli, it's possible that some of the participants didn't appreciate the difference in the packaging material design variable. In the stimuli design stage, care was taken to ensure that the metallized finish was much more shiny than the matt finish chosen for the paper finish, and photorealistic renderings were used for the creation of the stimuli used. In addition, before starting the survey it was indicated that some of the packages that were going to be evaluated were paper or metallized and any of the conventional mediums used by the participants (PCs, smartphones, tablets…) have a high resolution. However it can't be ruled out that the effect of the material on the results of the study was much less significant owing to this circumstance.

The similarity of the images used in this study ("Ready" and "In Process") with those of existing brands may have influenced the scoring of certain attributes, since the images could have brought to mind experiences and sensations produced when previously consuming those brands. Nonetheless, to try to avoid this interference a neutral design was used in which other packaging design variables — such as colour, lettering and brand name — differed greatly from those of real brands.

The sample of consumers who participated in this study is biased concerning education, given that almost two thirds (63.8%) stated they held university qualifications. Similarly, 21% of the participants stated that they were not regular consumers of the product. Consequently there are limitations with respect to the participants' diversity and characteristics, meaning that further testing would be needed to see if these results can be extrapolated to the general public.

In future lines of research, it would be interesting to further investigate into the relationship between the packaging material and the sensory attributes of the product. The results obtained in this paper indicate that the influence of the material is concealed by the strong effect of the main image on the packaging. Nevertheless, there are some interesting results that are worthy of a more comprehensive study. In this sense, this research could be extended with a tasting of the product in which the participant could physically interact with the packaging to ensure that the differences in the material of the stimuli are perceived and thus test whether the results obtained are extrapolated in a tasting setting. In addition to the different stimuli used in this experiment, a blinded tasting could be added in which only the intrinsic properties of the product were evaluated, since previous studies have proved reported consumer experience changes in blind (i.e. without seeing the packaging) and package (i.e. seeing the packaging) conditions (Chaya, Pacoud, Ng, Fenton, & Hort, 2015; Hersleth, Monteleone, Segtnan, & Næs, 2015; Ng, Chaya, & Hort, 2013).

Furthermore, and also motivated by the greater importance of the oil cruet in part II of the experiment, it could be interesting to explore

the option of using visual or verbal cues to transmit secondary messages in contexts in which there is no main image, or when the secondary message to be transmitted does not have a mainly positive implication for the consumer (e.g. to communicate sensory properties like flavour and aroma).

Moreover, although this paper has not identified differences between the results obtained in terms of gender, age or level of education of the participants, it would be interesting to explore other associations, such as whether or not there are intercultural differences when assessing the design variables and attributes that have been analysed in this paper, in line with papers such as that of Piqueras-Fiszman et al. (2012).

5. Conclusion

This research show that some design decisions can influence consumer expectations about the product even before purchasing it. Therefore the way in which the product is represented in the image displayed on a bag of crisps influences consumer perception. Of particular interest is the fact that when the image shows crisps that are ready for consumption, willingness to buy is higher than when the image shows the process of transforming uncooked potatoes to crisps. The material used for the bag of crisps also influences consumer perception, although less so than the product image. One of the main findings was that a bag with a paper surface finish obtained higher scores in relation to the attribute *High quality*. This experiment has demonstrated that, the fact that the crisps are fried in olive oil is transmitted better through visual cues (displaying the image of an oil cruet) than via verbal cues (displaying the text "with olive oil"). The results presented in this paper highlight the importance of packaging on customer expectations and willingness to buy. These results are of interest to packaging designers and to manufacturers, marketers and professionals in the sector to provide information on the way in which the aspects related with the packaging influence the way in which consumers evaluate the product.

References

Ampuero, O., & Vila, N. (2006). Consumer perceptions of product packaging. *Journal of Consumer Marketing*, *23*(2), 100–112. http://dx.doi.org/10.1108/07363760610655032.

Becker, L., van Rompay, T. J. L., Schifferstein, H. N. J., & Galetzka, M. (2011). Tough package, strong taste: The influence of packaging design on taste impressions and product evaluations. *Food Quality and Preference*, *22*(1), 17–23. http://dx.doi.org/10.1016/j.foodqual.2010.06.007.

Biggs, L., Juravle, G., & Spence, C. (2016). Haptic exploration of plateware alters the perceived texture and taste of food. *Food Quality and Preference*, *50*, 129–134. http://dx.doi.org/10.1016/j.foodqual.2016.02.007.

Carroll, J. D., & Chang, J.-J. (1970). Analysis of individual differences in multidimensional scaling via an n-way generalization of "Eckart-Young" decomposition. *Psychometrika*, *35*(3), 283–319. http://dx.doi.org/10.1007/BF02310791.

Chae, B., & Hoegg, J. (2013). The future looks "right": Effects of the horizontal location of advertising images on product attitude. *Journal of Consumer Research*, *40*(2).

Chaya, C., Pacoud, J., Ng, M. L., Fenton, A., & Hort, J. (2015). Measuring the emotional response to beer and the relative impact of sensory and packaging cues. *Journal of the American Society of Brewing Chemists*. http://dx.doi.org/10.1094/ASBCJ-2015-0114-01.

Chen, X., Barnes, C. J., Childs, T. H. C., Henson, B., & Shao, F. (2009). Materials' tactile testing and characterisation for consumer products' affective packaging design. *Materials & Design*, *30*(10), 4299–4310. http://dx.doi.org/10.1016/j.matdes.2009.04.021.

Deliza, R., Macfie, H., & Hedderley, D. (2003). Use of computer-generated images and conjoint analysis to investigate sensory expectations. *Journal of Sensory Studies*, *18*(6), 465–486. http://dx.doi.org/10.1111/j.1745-459X.2003.tb00401.x.

Deliza, R., & MacFie, H. J. H. (1996). The generation of sensory expectation by external cues and its effect on sensory perception and hedonic ratings: A review. *Journal of Sensory Studies*, *11*(2), 103–128. http://dx.doi.org/10.1111/j.1745-459X.1996.tb00036.x.

Duizer, L. (2001). A review of acoustic research for studying the sensory perception of crisp, crunchy and crackly textures. *Trends in Food Science & Technology*, *12*(1), 17–24. http://dx.doi.org/10.1016/S0924-2244(01)00050-4.

Grabenhorst, F., Rolls, E. T., & Bilderbeck, A. (2008). How cognition modulates affective responses to taste and flavor: Top-down influences on the orbitofrontal and pregenual cingulate cortices. *Cerebral Cortex*, *18*(7), 1549–1559. http://dx.doi.org/10.1093/cercor/bhm185.

Hammond, D., Fong, G. T., Borland, R., Cummings, K. M., McNeill, A., & Driezen, P. (2007). Text and graphic warnings on cigarette packages: Findings from the International Tobacco Control Four Country Study. *American Journal of Preventive Medicine*, *32*(3), 202–209. http://dx.doi.org/10.1016/j.amepre.2006.11.011.

Hersleth, M., Monteleone, E., Segtnan, A., & Næs, T. (2015). Effects of evoked meal contexts on consumers' responses to intrinsic and extrinsic product attributes in dry-cured ham. *Food Quality and Preference*, *40*, 191–198. http://dx.doi.org/10.1016/j.foodqual.2014.10.002.

Honea, H., & Horsky, S. (2012). The power of plain: Intensifying product experience with neutral aesthetic context. *Marketing Letters*, *23*(1), 223–235. http://dx.doi.org/10.1007/s11002-011-9149-y.

Horan, C. B. (1969). Multidimensional scaling: Combining observations when individuals have different perceptual structures. *Psychometrika*, *34*(2), 139–165. http://dx.doi.org/10.1007/BF02289341.

Jaeger, S. R., & MacFie, H. J. H. (2001). The effect of advertising format and means-end information on consumer expectations for apples. *Food Quality and Preference*, *12*(3), 189–205. http://dx.doi.org/10.1016/S0950-3293(00)00044-6.

Kauppinen-Räisänen, H., Owusu, R. A., & Abeeku Bamfo, B. (2012). Brand salience of OTC pharmaceuticals through package appearance. *International Journal of Pharmaceutical and Healthcare Marketing*, *6*(3), 230–249. http://dx.doi.org/10.1108/17506121211259403.

Klatzky, R. L., Lederman, S. J., & Matula, D. E. (1993). Haptic exploration in the presence of vision. *Journal of Experimental Psychology. Human Perception and Performance*, *19*(4), 726–743. http://dx.doi.org/10.1037/0096-1523.19.4.726.

Kobayashi, M. L., & de Benassi, M. T. (2015). Impact of packaging characteristics on consumer purchase intention: Instant coffee in refill packs and glass jars. *Journal of Sensory Studies*, 1–12. http://dx.doi.org/10.1111/joss.12142.

Krishna, A., & Morrin, M. (2008). Does touch affect taste? The perceptual transfer of product container haptic cues. *Journal of Consumer Research*, *34*(6), 807–818. http://dx.doi.org/10.1086/523286.

Kruskal, J. B., & Wish, M. (1984). *Multidimensional scaling*. Beverly Hills and London: Sage Publications.

Labbe, D., Pineau, N., & Martin, N. (2013). Food expected naturalness: Impact of visual, tactile and auditory packaging material properties and role of perceptual interactions. *Food Quality and Preference*, *27*(2), 170–178. http://dx.doi.org/10.1016/j.foodqual.2012.06.009.

Lähteenmäki, L., Lampila, P., Grunert, K., Boztug, Y., Ueland, Ø., Åström, A., & Martinsdóttir, E. (2010). Impact of health-related claims on the perception of other product attributes. *Food Policy*, *35*(3), 230–239. http://dx.doi.org/10.1016/j.foodpol.2009.12.007.

Leeuw, J., & Heiser, W. J. (1980). Multidimensional scaling with restrictions on the configuration. In P. R. Krishnaiah (Ed.), *Multivariate analysis* (pp. 501–522). (Amsterdam, the Netherlands: North-Holland).

Liao, L. X., Corsi, A. M., Chrysochou, P., & Lockshin, L. (2015). Emotional responses towards food packaging: A joint application of self-report and physiological measures of emotion. *Food Quality and Preference*, *42*, 48–55. http://dx.doi.org/10.1016/j.foodqual.2015.01.009.

Liem, D. G., Toraman Aydin, N., & Zandstra, E. H. (2012). Effects of health labels on expected and actual taste perception of soup. *Food Quality and Preference*, *25*(2), 192–197. http://dx.doi.org/10.1016/j.foodqual.2012.02.015.

de Liz Pocztaruk, R., Abbink, J. H., de Wijk, R. A., da Fontoura Frasca, L. C., Gavião, M. B. D., & van der Bilt, A. (2011). The influence of auditory and visual information on the perception of crispy food. *Food Quality and Preference*, *22*(5), 404–411. http://dx.doi.org/10.1016/j.foodqual.2010.11.008.

López-Miranda, J., Pérez-Jiménez, F., Ros, E., De Caterina, R., Badimón, L., Covas, M. I., ... Yiannakouris, N. (2010). Olive oil and health: Summary of the II international conference on olive oil and health consensus report, Jaén and Córdoba (Spain) 2008. *Nutrition, Metabolism, and Cardiovascular Diseases*, *20*(4), 284–294. http://dx.doi.org/10.1016/j.numecd.2009.12.007.

Machiels, C. J. A., & Karnal, N. (2016). See how tasty it is? Effects of symbolic cues on product evaluation and taste. *Food Quality and Preference*, *52*, 195–202. http://dx.doi.org/10.1016/j.foodqual.2016.04.014.

Madzharov, A. V., & Block, L. G. (2010). Effects of product unit image on consumption of snack foods. *Journal of Consumer Psychology*, *20*(4), 398–409. http://dx.doi.org/10.1016/j.jcps.2010.06.007.

Magnier, L., & Schoormans, J. (2015). Consumer reactions to sustainable packaging: The interplay of visual appearance, verbal claim and environmental concern. *Journal of Environmental Psychology*, *44*, 53–62. http://dx.doi.org/10.1016/j.jenvp.2015.09.005.

Magnier, L., Schoormans, J., & Mugge, R. (2016). Judging a product by its cover: Packaging sustainability and perceptions of quality in food products. *Food Quality and Preference*, *53*, 132–142. http://dx.doi.org/10.1016/j.foodqual.2016.06.006.

Maynard, O. M., Munafò, M. R., & Leonards, U. (2013). Visual attention to health warnings on plain tobacco packaging in adolescent smokers and non-smokers. *Addiction*, *108*(2), 413–419. http://dx.doi.org/10.1111/j.1360-0443.2012.04028.x.

McQuarrie, E. F., & Mick, D. G. (2003). Visual and verbal rhetorical figures under directed processing versus incidental exposure to advertising. *Journal of Consumer Research*, *29*(4), 579–587. http://dx.doi.org/10.1086/346252.

McQuarrie, E. F., & Phillips, B. J. (2005). Indirect persuasion in advertising: How consumers process metaphors presented in pictures and words. *Journal of Advertising*, *34*(2), 7–20. http://dx.doi.org/10.1080/00913367.2005.10639188.

Mueller, S., Lockshin, L., & Louviere, J. J. (2009). What you see may not be what you get: Asking consumers what matters may not reflect what they choose. *Marketing Letters*, *21*(4), 335–350. http://dx.doi.org/10.1007/s11002-009-9098-x.

Mutsikiwa, M., & Marumbwa, J. (2013). The impact of aesthetics package design elements on consumer purchase decisions: A case of locally produced dairy products. *Journal of Business and Management*, *8*(5), 64–71.
Neyens, E., Aerts, G., & Smits, T. (2015). The impact of image-size manipulation and sugar content on children's cereal consumption. *Appetite*, *95*, 152–157. http://dx.doi.org/10.1016/j.appet.2015.07.003.
Ng, M., Chaya, C., & Hort, J. (2013). The influence of sensory and packaging cues on both liking and emotional, abstract and functional conceptualisations. *Food Quality and Preference*, *29*(2), 146–156. http://dx.doi.org/10.1016/j.foodqual.2013.03.006.
Nisbett, R. E., & Wilson, T. D. (1977). The halo effect: Evidence for unconscious alteration of judgments. *Journal of Personality and Social Psychology*, *35*(4), 250–256. http://dx.doi.org/10.1037/0022-3514.35.4.250.
Okamoto, M., Wada, Y., Yamaguchi, Y., Kimur, A., Dan, H., Masuda, T., ... Dan, I. (2009). Influences of food-name labels on perceived tastes. *Chemical Senses*, *34*(3), 187–194. http://dx.doi.org/10.1093/chemse/bjn075.
Orth, U. R., & Malkewitz, K. (2008). Holistic package design and consumer brand impressions. *Journal of Marketing*, *72*(3), 64–81. http://dx.doi.org/10.1509/jmkg.72.3.64.
Orth, U. R., & Marchi, R. D. (2007). Understanding the relationships between functional, symbolic, and experiential brand beliefs, product experiential attributes, and product schema: Advertising-trial interactions revisited. *Journal of Marketing Theory and Practice*, *15*(3), 219–233.
Peck, J., & Childers, T. L. (2003). To have and to hold: The influence of haptic information on product judgments. *Journal of Marketing*, *67*(2), 35–48. http://dx.doi.org/10.1509/jmkg.67.2.35.18612.
Phillips, B. J. (2000). The impact of verbal anchoring on consumer response to image ads. *Journal of Advertising*, *29*(1), 15–24. http://dx.doi.org/10.1080/00913367.2000.10673600.
Piqueras-Fiszman, B., & Spence, C. (2011). Crossmodal correspondences in product packaging. Assessing color-flavor correspondences for potato chips (crisps). *Appetite*, *57*(3), 753–757. http://dx.doi.org/10.1016/j.appet.2011.07.012.
Piqueras-Fiszman, B., & Spence, C. (2012). The influence of the feel of product packaging on the perception of the oral-somatosensory texture of food. *Food Quality and Preference*, *26*(1), 67–73. http://dx.doi.org/10.1016/j.foodqual.2012.04.002.
Piqueras-Fiszman, B., & Spence, C. (2015). Sensory expectations based on product-extrinsic food cues: An interdisciplinary review of the empirical evidence and theoretical accounts. *Food Quality and Preference*, *40*(PA), 165–179. http://dx.doi.org/10.1016/j.foodqual.2014.09.013.
Piqueras-Fiszman, B., Velasco, C., & Spence, C. (2012). Exploring implicit and explicit crossmodal colour-flavour correspondences in product packaging. *Food Quality and Preference*, *25*(2), 148–155. http://dx.doi.org/10.1016/j.foodqual.2012.02.010.
Rayner, K., Rotello, C. M., Stewart, A. J., Keir, J., & Duffy, S. A. (2001). Integrating text and pictorial information: Eye movements when looking at print advertisements. *Journal of Experimental Psychology: Applied*, *7*(3), 219–226. http://dx.doi.org/10.1037/1076-898X.7.3.219.
Rebollar, R., Lidón, I., Gil, I., Martín, J., Fernández, M. J., & Riveres, C. E. (2016). The influence the serving suggestion displayed on soft cheese packaging has on consumer expectations and willingness to buy. *Food Quality and Preference*, *52*, 188–194. http://dx.doi.org/10.1016/j.foodqual.2016.04.015.
Rebollar, R., Lidón, I., Martín, J., & Puebla, M. (2015). The identification of viewing patterns of chocolate snack packages using eye-tracking techniques. *Food Quality and Preference*, *39*, 251–258. http://dx.doi.org/10.1016/j.foodqual.2014.08.002.
Rebollar, R., Lidón, I., Serrano, A., Martín, J., & Fernández, M. J. (2012). Influence of chewing gum packaging design on consumer expectation and willingness to buy. An analysis of functional, sensory and experience attributes. *Food Quality and Preference*, *24*, 162–170. http://dx.doi.org/10.1016/j.foodqual.2011.10.011.
van Rompay, T. J. L., & Veltkamp, M. (2014). Product packaging metaphors: Effects of ambiguity and explanatory information on consumer appreciation and brand perception. *Psychology and Marketing*, *31*(6), 404–415. http://dx.doi.org/10.1002/mar.20703.
Schifferstein, H. N. J., Fenko, A., Desmet, P. M. A., Labbe, D., & Martin, N. (2013). Influence of package design on the dynamics of multisensory and emotional food experience. *Food Quality and Preference*, *27*(1), 18–25. http://dx.doi.org/10.1016/j.foodqual.2012.06.003.
Schiffman, S. S., Reynolds, M. L., & Young, F. W. (1981). Introduction to multidimensional scaling. *Theory, methods and applications*. New York: Academic Press.
Sehrawet, M., & Kundu, S. C. (2007). Buying behaviour of rural and urban consumers in India: The impact of packaging. *International Journal of Consumer Studies*, *31*(6), 630–638. http://dx.doi.org/10.1111/j.1470-6431.2007.00629.x.
Silayoi, P., & Speece, M. (2007). The importance of packaging attributes: A conjoint analysis approach. *European Journal of Marketing*, *41*(11/12), 1495–1517. http://dx.doi.org/10.1108/03090560710821279.
Simmonds, G., & Spence, C. (2016). Thinking inside the box: How seeing products on, or through, the packaging influences consumer perceptions and purchase behaviour. *Food Quality and Preference*, 1–12. http://dx.doi.org/10.1016/j.foodqual.2016.11.010.
Siret, F., & Issanchou, S. (2000). Traditional process: Influence on sensory properties and on consumers' expectation and liking application to "pâté de campagne.". *Food Quality and Preference*, *11*(3), 217–228. http://dx.doi.org/10.1016/S0950-3293(99)00058-0.
Smith, V., Barratt, D., & Selsøe Sørensen, H. (2015). Do natural pictures mean natural tastes? Assessing visual semantics experimentally. *Cognitive Semiotics*, *8*(1), 53–86. http://dx.doi.org/10.1515/cogsem-2015-0001.
Spence, C. (2016). Multisensory packaging design: Color, shape, texture, sound, and smell. *Integrating the packaging and product experience in food and beverages* (pp. 1–22). . http://dx.doi.org/10.1016/B978-0-08-100356-5.00001-2.
Spence, C., & Piqueras-Fiszman, B. (2014). Tastes great, but what do we call it? The art and Science of food description. *The perfect meal* (pp. 71–107). Chichester, UK: John Wiley & Sons, Ltd. http://dx.doi.org/10.1002/9781118491003.ch3.
Sundar, A., & Noseworthy, T. J. (2014). Place the logo high or low? Using conceptual metaphors of power in packaging design. *Journal of Marketing*, *78*(5), 138–151. http://dx.doi.org/10.1509/jm.13.0253.
Sütterlin, B., & Siegrist, M. (2015). Simply adding the word "fruit" makes sugar healthier: The misleading effect of symbolic information on the perceived healthiness of food. *Appetite*, *95*, 252–261. http://dx.doi.org/10.1016/j.appet.2015.07.011.
Tu, Y., Yang, Z., & Ma, C. (2015). Touching tastes: The haptic perception transfer of liquid food packaging materials. *Food Quality and Preference*, *39*, 124–130. http://dx.doi.org/10.1016/j.foodqual.2014.07.001.
Underwood, R. L., & Klein, N. M. (2002). Packaging as brand communication: Effects of product pictures on consumer responses to the package and brand. *Journal of Marketing Theory and Practice*, *10*(4), 58–68.
Venter, K., van der Merwe, D., de Beer, H., Kempen, E., & Bosman, M. (2011). Consumers' perceptions of food packaging: An exploratory investigation in Potchefstroom, South Africa. *International Journal of Consumer Studies*, *35*(3), 273–281. http://dx.doi.org/10.1111/j.1470-6431.2010.00936.x.
Verbeke, G., & Molenberghs, G. (2009). *Linear mixed models for longitudinal data*. New York: Springer Science & Business Media.
Yeomans, M. R., Chambers, L., Blumenthal, H., & Blake, A. (2008). The role of expectancy in sensory and hedonic evaluation: The case of smoked salmon ice-cream. *Food Quality and Preference*, *19*(6), 565–573. http://dx.doi.org/10.1016/j.foodqual.2008.02.009.
Zampini, M., & Spence, C. (2004). The role of auditory cues in modulating the perceived crispness and staleness of potato chips. *Journal of Sensory Studies*, *19*(5), 347–363. http://dx.doi.org/10.1111/j.1745-459x.2004.080403.x.

3.2. Study 2

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Images used to convey that a natural yogurt is sweetened influence consumer expectations and willingness to buy

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INTERPRETIVE SUMMARY

Images used to convey that a natural yogurt is sweetened influence consumer expectations and willingness to buy. Rebollar. We studied how the image depicted on the packaging to convey that a natural yogurt is sweetened influences consumer expectations and willingness to buy, for which we conducted an online survey and a Word Association task. Our results show that the effect the images exert on consumer expectations and response depends on what is depicted on them and that willingness to buy is positively associated with healthiness, naturalness and quality perception. This results are discussed and prove that dairy companies can improve the marketing performance of their products by manipulating the image showed on their packages.

CONVEYING YOGURT SWEETNESS THROUGH IMAGES

Images used to convey that a natural yogurt is sweetened influence consumer expectations and willingness to buy

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ABSTRACT

Literature shows that packaging appearance has an important effect on shaping consumer expectations and behavior towards the product. However, little is known about how conveying relevant information about the product through an image depicted on the packaging influences consumer perception and response. The objective of this study was to assess how the image depicted on the packaging to convey that a natural yogurt is sweetened influences consumer expectations and willingness to buy. Four packages of natural yogurt were designed, in which the message that they were sweetened was conveyed through three different images (some sugar cubes, a spoon of sugar and a sack of sugar) and through only text. The results obtained by means of conducting an online survey and a Word Association task show that yogurts whose front label indicates it is a sweetened product using an image and not only text are perceived as sweeter although some differences can be appreciated depending on the way sugar is depicted. Willingness to buy is positively associated with such attributes as Healthy, Quality and Natural Ingredients and in a slightly negative way with the attribute Sweet. Overall, the results suggest that when designing packaging for natural sweetened yogurts, producers and designers face a challenge of clearly communicating that the yogurt is sweetened without it having a negative impact on willingness to buy. These findings can help dairy companies and packaging designers to better communicate the desired message to consumers and to improve the marketing performance of their products.

KEY WORDS

sweetened natural yogurt; visual cue; verbal cue; expectation; willingness to buy

INTRODUCTION

Spanish households spend 8.59% of their food budget on dairy products. The fermented milk category is the one that has greater presence in households, accounting for 38.7% of the sales and 15.34 liters per person per year consumption. Within this category, yogurt plays a key role and accounts for 65.2% of sales in the category of fermented milk (MAPAMA, 2017). Consumption of yogurt and fermented milk is associated with numerous health benefits and both products are among the most common fresh dairy products consumed around the world (Donovan and Shamir, 2014).

In Spain, different types of yogurts are classified as follows: natural yogurts, natural sugar-sweetened yogurts, sweetened yogurts, fruit yogurts, juices and/or other foods, flavored yogurts and yogurts pasteurized after fermentation (BOE, 2014). Natural sweetened yogurts are those natural yogurts in which edible sugar or sugars were added. As far as the energy level is concerned, it means that the average of 64 kcal in natural yogurts can reach up to 100 kcal in natural sweetened yogurts (BEDCA, 2018). The advantage of natural sweetened yogurts is that consumers do not need any additional products (sugar) to eat it with. Roughly 50% of people add sugar to natural yogurts before eating them and some studies have shown that the average amount of sugar added to natural yogurts is above the average amount of sugar that natural sweetened yogurts contain (Saint-Eve et al., 2016).

Due to its intrinsic characteristics, such as its creamy texture and its rapid degradation, sweetened yogurt is always marketed packed. Yet, research has shown that the functions of food packaging go well beyond the protection and handling of the product given that packaging has the ability to grab consumer attention and to influence consumer expectations and response (Rundh, 2005, 2009, 2013). Indeed, literature shows that

consumer perception and attitude may be affected by physical packaging cues such as its shape (Becker et al., 2011; Rebollar et al., 2012; Velasco et al., 2016) or its weight (Piqueras-Fiszman and Spence, 2012), and by visual cues such as its material (Magnier and Schoormans, 2017; Rebollar et al., 2017), its color (Piqueras-Fiszman and Spence, 2015; Spence, 2018) or even the typography used in the label texts (Velasco et al., 2014; Celhay et al., 2015).

However, despite being one of the most common food packaging design elements and a prominent visual cue (Underwood and Klein, 2002), not so many studies have addressed thus far the effect that the image depicted on food packaging has on consumer expectations and response. To date, studies conducted with this aim have focused on assessing the effect of the image on consumer sensory perception (Mizutani et al., 2010; Machiels and Karnal, 2016), on consumer emotional response (Liao et al., 2015), or on its influence in different aspects of consumer behavior such as consumption amount (Madzharov and Block, 2010; Neyens et al., 2015) or consumer willingness to buy (Bone and France, 2001). More recently, Rebollar et al. (2016) showed that the product that appears with fresh cheese in the image on the package influences the expectations that consumers have about characteristics of that fresh cheese.

Given that packaging is a key communication tool between producers and consumers (Nancarrow et al., 1998; Celhay and Remaud, 2018), one of the main objectives of the images shown on food packaging is to convey messages to the consumer (Underwood and Klein, 2002; Ares et al., 2011). Consumers infer meaning from the images that appear on packages and consequently use them to identify and categorize products, as well as to generate expectations regarding their attributes (Loken, 2006; Piqueras-Fiszman and Spence, 2015). Thus, images are commonly used by packaging designers

in order to convey messages or ideas to the consumer, and they are, together with verbal cues, the most frequently used cues for this purpose (Piqueras-fiszman et al., 2011; Kauppinen-Räisänen et al., 2012; Machiels and Karnal, 2016). However, compared to verbal cues images more easily attract consumer attention at the point of sale (Venter et al., 2011; Honea and Horsky, 2012) and require a lower level of cognitive effort, as they are processed in a more unintentional and unconscious way (Underwood and Klein, 2002; Mueller et al., 2009). As a consequence, consumers generate expectations more quickly by looking at an image than by reading a text (Underwood and Klein, 2002).

It should be noted that this communication process can be very complex as designers often have to convey several messages to consumers, for which they can rely on different packaging cues (Ares et al., 2011; Laing and Masoodian, 2016). Among all the possible cues, the most appropriate will be those that correctly transmit the desired message and at the same time have a more positive impact on consumer's response. For example, in the case of a sweetened natural yogurt the designer must clearly communicate a main message (i.e. the product category, *natural yogurt*) and a secondary message (i.e. the product subcategory, *sweetened*); in this case, it is reasonable to wonder what kind of cue will be the most adequate for each message. Whereas previous studies analyzed the consequences of using one or another kind of cue in order to convey the main message (e.g. the product category, Bone and France, 2001; Underwood and Klein, 2002) and even suggested that the packaging shape can be used for that purpose (Arboleda and Arce-Lopera, 2015; Velasco et al., 2016), it is not clear which kind of cue (i.e. whether visual or verbal) is the most adequate to communicate a secondary message (e.g. that a natural yogurt is sweetened) and how this decision may influence consumer expectations and willingness to buy.

According to previous findings, one may think that conveying that the yogurt is sweetened through an image rather than through a text is preferable in order to improve consumer attitude towards the product (Underwood and Klein, 2002; Rebollar et al., 2016). For example, Rebollar et al. (2017) showed that indicating that the chips contained in a bag of chips had been fried in olive oil by using a visual cue rather than a verbal cue enhanced willingness to buy and consumer expectations for all the assessed attributes. However, the question arises of what the differences would be depending on the specific image selected as visual cue. Findings of previous investigations on the manipulation of the main image that is shown on the package suggest that what is depicted makes an impact on consumer expectations and response (Mizutani et al., 2010; Machiels and Karnal, 2016), which proves it is necessary to verify whether if it can also be the case of conveying a secondary message like that a natural yogurt is sweetened. In addition, Rebollar et al. (2017) explained their results arguing that using a visual cue instead of a verbal cue had improved the expectations and willingness to buy because by doing so the secondary message conveyed on their package (i.e. that the chips were fried in olive oil), which in that case was perceived as positive by consumers (López-Miranda et al., 2010), gained more prominence. However, in the case of natural sweetened yogurts the secondary message does not have a clearly positive connotation due to the fact that many consumers associate sugar consumption and sweet products with various illnesses (Lustig et al., 2012; Sütterlin and Siegrist, 2015). Hence, it is worth considering if in this case giving more prominence to the message that the yogurt is sweetened by means of the image shall have a positive effect.

To summarize, the specific aim of the present study was to analyze how the image shown on the package to communicate that a natural yogurt has been sweetened affects both consumer expectations for certain sensory and non-sensory attributes and the

willingness to buy the product. To that end, an online survey and a Word Association task were conducted.

MATERIALS AND METHODS

Experimental Overview

The experiment performed consisted of two parts. In the first one, an online survey was carried out. In it, the participants were asked to evaluate their expectations of four sensory and non-sensory attributes marked as relevant for this product by a panel of experts (Sweet, Healthy, Quality and Natural Ingredients) as well as their willingness to buy in relation to different packages of natural sweetened yogurt. In the second part of the experiment, a Word Association task was done using the same packages as in the earlier online survey.

Samples

A market study was carried out prior to the design of the stimuli to know the most frequent characteristics of the packages of sweetened natural yogurt sold in the Spanish market. According to its findings, four kinds of stimuli were designed in a way they would resemble the appearance any of these products might have on the market. Each package included the same elements: the words ‘‘Yogur Natural Azucarado” (sweetened natural yoghurt, in English), an image of a cow, the brand (Yulé – created specifically for this investigation so that the participants could not deduce certain attributes of the products based on their prior experiences with other brands), the nutrition information and other symbols (barcode, recycled package…). The only difference between packages was the image shown to indicate that yogurt was sweetened. The images used were the ones more commonly seen in these kinds of

166 yogurt packages: sugar cubes, a spoon of sugar, a sack of sugar and no image. These
167 stimuli will be hereafter referred to, respectively, as *Sugar cubes*, *Sugar sack*, *Sugar*
168 *spoon* and *Only text*.

169 The visual stimuli used in the experiments were photorealistic renderings created using
170 Photoshop CS5 (Adobe Systems Inc., San Jose, CA, U.S.A.) and Keyshot 4 (Luxion
171 Inc., Tustin, CA, U.S.A.). The packages can be seen in Fig. 1.

172 ***Online Survey***

173 The online survey was conducted via social media on a voluntary and anonymous basis,
174 using an online survey data collection tool: SurveyMonkey™. Participants were not
175 given a time limit to complete the survey or any particular section thereof. They were
176 shown photorealistic renderings (Figure 1) and given a questionnaire to evaluate them.
177 A within-subject experimental design was used, so all survey participants saw the same
178 packages randomly displayed.

179 157 people participated in this investigation—60.5% females (95) and 39.5% (62)
180 males—all residing in Spain. Their mean age was 29.1 years with a standard deviation
181 of 10.1 years.

182 The survey was divided into two sections: control questions to identify the participants
183 (age and gender) and the presentation of the packages to analyze—the visual stimuli in
184 Figure 1. For each package, the survey evaluated a total of four product attributes
185 identified and chosen by a panel of experts, selected for being seen as particularly
186 relevant in case of natural sweetened yogurts: one sensory attribute (Sweet) and three
187 non-sensory attributes (Quality, Healthy, and Natural Ingredients).

Participants were asked to evaluate the four product attributes for each of the four packages according to a LIKERT scale of 1 (strongly disagree) to 7 (strongly agree). Willingness to buy was evaluated using the same LIKERT scale of 1 (would not buy under any circumstances) to 7 (would be definitely willing to buy). It was specified that all the products contained the same quantity of yogurt and had the same cost, though the price was not specified.

Word Association

Word Association is a qualitative research technique usually used in sociology and psychology (Schmitt, 1998). This technique is based on free answers given by the participant as a response to a stimulus; these answers provide a better understanding of the mental representation that consumers have of the stimulus in question. When this technique is applied to food, the answers given make it possible to identify the most relevant concepts for consumer's buying decisions (Roininen et al., 2006).

112 people participated in this investigation, other than those who took part in the online survey—55.4% females (62) and 44.6% (50) males—all residing in Spain. Their mean age was 33.5 years with a standard deviation of 13.5 years. The participants were randomly divided into 4 groups of 28 people. No statistically relevant difference was found in the composition of groups regarding age and gender.

Each group of participants performed a task with one of the four stimuli shown in the Figure 1. Participants were asked to evaluate the stimuli and to write down the first three words, associations, thoughts or feelings that came to their minds. The stimuli were shown on a 23" LED monitor with a resolution of 1920 x 1080px and a refresh

rate of 60Hz and was of a similar size to the real-life package. There was no time limitation to perform the task and participants could write one, two or three ideas.

Statistical Analyses

In the online survey, each attribute was individually analyzed using one-way repeated measures analysis of variance (within-subjects ANOVA). For the comparisons of pairs following the analysis of variance, the Bonferroni correction was used.

To study the preference of individuals for different packages, the Individual Differences Model was used (Horan, 1969; Carroll and Chang, 1970). This technique is included within multidimensional scaling techniques and has been used primarily to characterize variation in judged stimulus structure across individuals.

This method is also known as INDSCAL. In this study, a matrix (4X4) of similarities between packages was calculated for each individual. These similarities were obtained from each individual score given to the different packages of yogurts in relation to their attributes. This technique allows the creation of a space of consensus for the individuals showing the similarities between the packages of yogurts. In addition, it is possible to find out the weights that each individual gave to the dimensions obtained in the consensus space. The weights reflect the importance that the individuals associate to the dimensions in the stimuli space. Although one person can perceive one of the dimensions to be more important than the other, another person can have the opposite perception.

This technique was used to evaluate the attributes, as well as willingness to buy. The analysis was conducted using the PROXCAL algorithm (Leeuw and Heiser, 1980), and Euclidian distance was used as a measure of similarity. The criterion to choose the

number of dimensions in the consensus space was based on goodness of fit and the number of stimuli included in the analysis. S-Stress was used to determine goodness of fit. If this measurement is low, it indicates that the configuration obtained in the map (or space) is good. Kruskal and Wish (1984) deem the solution to be acceptable when the S-Stress values are less than 0.1.

The vector model (Schiffman et al., 1981) was used to interpret the dimensions of preference in accordance with the observable attributes. This procedure uses the multiple-regression technique to determine the direction of the attributes. The means of the individual scores of attributes are used to calculate the multiple regression, and the standardized regression coefficients ($\hat{\beta}_1$; $\hat{\beta}_2$; $\hat{\beta}_3$) are computed and drawn as coordinates in the three-dimensional stimulus space. Finally, a line is drawn through the origin of the stimulus consensus space and through coordinates defined by the regression coefficients. This model helps to interpret the dimensions of the space of similarities using the attributes forming the similarities between the stimuli. Moreover, the attribute-vector is shown as a line in the space representing packages of yogurts in which the projection of each stimulus corresponds to the level of attributes possessed by that stimulus. If the attribute in question is strongly related with the stimuli space, then the projections of the stimuli will coincide very closely with the value of the attribute and the correlation between the projection and the attribute will be quite high. When two attributes are facing in the same direction, this also indicates a high correlation. When the points that represent the vector are close to a dimension and far from the center, it means they are relevant for explaining that dimension. If an attribute is in a position halfway between two dimensions, it indicates that the attribute is explained in both dimensions. If a vector-attribute is close to the center of the stimuli space, it means that it is insignificant in the explanation of the dimensions of that space. This model

allowed the packages to be ordered according to each of the attributes evaluated by the subjects. It also made it possible to determine which attributes had a high correlation in the stimuli evaluation. Subjects' willingness to buy was included as an external value to explore the dimension with the highest correlation.

In the word association task, all associations made by the participant were analysed qualitatively. The terms with similar meaning were grouped together using inter-rater consensus technique (Glaser and Strauss, 1967; Armstrong et al., 1997). Each member individually evaluated the results and, consequently, the classification of the final categories was agreed on by three raters. This triangulation technique has been used by other authors dealing with qualitative techniques (Guerrero et al., 2010). Only those categories that were mentioned by at least 5 people were taken into consideration (Piqueras-Fiszman et al., 2013).

HJ biplot (Galindo, 1986) was used to analyze the word association task. This exploratory technique is a variant of the Biplot methods proposed by Gabriel (1971). The Biplot methods make it possible to plot the rows (stimuli) and columns (words) of the data matrix as points on a low dimension vector space. The interpretation of this method is similar to other multivariate techniques. The distances between row makers are interpreted as an inverse function of similarities, so closer makers (stimuli) are more similar. The cosines of the angles between the column vectors (words) approximate the correlation between variables in such a way that small acute angles are associated with high positive correlations, obtuse angles are associated with negative correlations and right angles are associated with uncorrelated variables. In the same way, the cosines of angles between the column makers (words) and the axes approximate the correlations between them. Besides, the order of the orthogonal projections of the row makers

(stimuli) onto column makers (words) approximates the order of the row values in that column of the data matrix.

SPSS Statistics 23 (Armonk, NY, U.S.A.) and MULTBIPLOT (Vicente-Villardón, 2015) were used for data processing.

RESULTS

Online Survey

All the results obtained using the variance technique analysis gave statistically significant values regarding both the four attributes tested and the willingness to buy the product. The results of the five analyses can be seen in Fig. 2.

Packages displaying the greatest difference in the results were those with the attribute Sweet. There is a marked difference between the *Sugar cubes* package in relation to the others, with the *Sugar cubes* package obtaining the highest mean value (5.47), and the *Only text* package obtaining the lowest mean value (4.48). After applying the Bonferroni correction *Sugar cubes* stimulus is found to have statistically relevant differences with the rest of stimuli and the same happens with *Only text* stimulus. The results relating to the three non-sensory attributes, Healthy, Quality and Natural Ingredients, also have a marked difference between their extreme values. All the attributes obtain structurally similar results, with the *Sugar cubes* package obtaining the lowest results and the *Sugar sack* stimulus obtaining the highest results. The results for Willingness to buy show that the package obtaining the highest value was the one depicting a *Sugar sack*, and the one with the lowest value was the one depicting *Sugar cubes*.

The consensus space obtained by the multidimensional analysis (Figure 3) shows similarities between the stimuli. The dimensionality chosen for the multidimensional scaling solution was that of three dimensions (S-Stress = 0.00233). The reason why three and not two dimensions were chosen was that S-Stress using two dimensions was close to 0.1 and *Sugar sack* stimulus was not represented accurately in a two-dimensional space.

The first dimension differentiates the *Sugar cubes* package from the *Only text* package. The second dimension differentiates the *Sugar sack* package from the rest of the packages. The third dimension differentiates the *Sugar spoon* package from the *Sugar cubes* package. Analysis of the layout of the packages regarding the attributes shows that the attributes Sweet and Healthy are closely associated with Dimension I. The attribute Natural Ingredients and Willingness to buy are closely associated with the Dimension II and the attribute Quality is equally associated with Dimensions II and III.

It can be seen how Willingness to Buy has a strong positive connection with the attributes Natural Ingredients, Healthy, and Quality and how, on the other hand, the attribute Sweet displays a strong negative connection with that Healthy and a weak connection with Willingness to buy.

In the analysis of individuals' weights, it can be seen that 72% gave similar importance to dimensions I, II and III, compared to 15% who gave most importance to dimension I and to 12% who gave more importance to dimension II. Only 1% of individuals rated only dimension III.

Word Association

The elicited words were clustered into 9 categories, corresponding to those mentioned by more than five participants (Piqueras-Fiszman et al., 2013). Table 1 shows how often each category was mentioned for each package (frequency). As shown in Table 1, the most mentioned associations were 'Natural yogurt', 'Nature' and 'Sugar'.

Figure 4 is obtained by depicting Table 1 through a biplot graph. The first two axes of the HJ-Biplot analysis explained 89.59% of the data variability. Axis 1 is mainly defined by the term 'Healthy' against 'Sugar' and 'Sweet'. This axis separates *Sugar cubes* and *Sugar sack* stimuli (more frequently associated with 'Sugar' and 'Sweet') from *Sugar spoon* and *Only text* stimuli (more frequently associated with 'Healthy'). Axis 2 is defined by the terms 'Yogurt' and 'Nature' against the term 'Fresh'. This axis separates *Sugar sack* stimulus against *Sugar cubes* and *Only text* with *Sugar spoon* stimulus occupying the intermediate position.

DISCUSSION

The main objective of this research was to analyze whether the images used on packages to convey the message that a yogurt package is sweetened make an impact on consumer expectations and on willingness to buy. The results of the current research enrich the literature on how the product extrinsic cues influence consumer expectations and response by showing that the image chosen to convey the message that the yogurt is sweetened influences both consumer sensory and non-sensory expectations and that it also affects willingness to buy. These findings enhance our understanding of the effects of conveying a secondary message on food packaging (in this case, indicating that

yogurt is sweetened) through different cues, thus helping both designers and producers to design clearer and more effective packages for their products.

The results of this study show that using an image or another does make an impact on consumer's sensory expectations, since packages with an image of sugar cubes generated higher sweetness expectations than packages that had an image of a spoon of sugar or that of a sack of sugar; the latter ones, in turn, were considered sweeter than packages with no image whatsoever (i.e. that had only text informing the yogurt was sweetened). This was reinforced by the findings obtained from the Word Association task, in which the association to the stimuli regarding the terms 'Sugar' and 'Sweet' proves to be the same. Indeed, the package that has only text and no images has the lowest expectations of consumers regarding sweetness. This result supports previous research which suggest that visual information is more powerful than verbal information (McQuarrie and Mick, 2003; McQuarrie and Phillips, 2005), and is in accordance with the findings by Rebollar et al. (2017) that suggested that conveying a secondary message by means of a visual cue enhanced consumer expectations. Indeed, Sehrawet and Kundu (2007) showed that, in the context of low-involvement products (such as yogurt), visual cues are more easily processed and allow to transmit information more quickly than verbal cues because of the higher level of effort involved in processing the text. In addition, in the other stimuli there is also a reinforcement of the sweetness concept when using a text along with images compared to using only text. This also seems to be reinforced by the findings of the Word Association task, since in the case of the stimulus showing only text the terms 'Sugar' and 'Sweet' are elicited less frequently than in any other stimuli.

371 Nevertheless, it is necessary to understand why some images raise higher sweetness
372 expectations than others. We propose that the reason for this is twofold: on the one
373 hand, it may be due to the amount of sugar that appears depicted on the image; on the
374 other, because of the easy association between some of the images and the everyday
375 action of adding sugar. As for the amount of sugar depicted on the image, both the
376 package showing a sack of sugar and the package showing sugar cubes depict an
377 amount of sugar that could be used to sweeten many yogurts, whereas a spoon of sugar
378 is associated with the sugar used to sweeten one yogurt only. The higher sweetness
379 expectations raised by the packages in which a sack of sugar and sugar cubes were
380 shown compared with those generated by the sugar spoon package suggest that people
381 infer that the amount of sugar depicted in the image is related to the amount of sugar
382 present in the yogurt. This supports the results of Madzharov and Block (2010), who
383 showed that the number of product units (e.g., number of cookies) displayed on the
384 package influences consumers' perceptions of the quantity of product (the more cookies
385 are depicted on the package, the more cookies consumers think there are contained
386 within). As for the associations with actions of adding sugar, when consumers' mental
387 representation of a target matches the way the target is presented, this fit increases
388 processing fluency (Chae and Hoegg, 2013) and increases the accessibility of the
389 depicted concept (González et al., 2006). Thus, sugar cubes and a spoon of sugar are
390 easily associated with the action of adding sugar to products, since they accurately
391 represent the way in which consumers are used to adding sugar to the yogurt: from a
392 semiotic point of view, the sign is congruent with the product in which it is applied and
393 it thus allows to easily access the concept of sweet in the consumer's mind (Lynott and
394 Connell, 2010; Ares et al., 2011; Smith et al., 2015). However, a sack of sugar is an
395 element that consumers do not associate with the action of adding sugar to products

since it does not fit into their everyday experience. Hence, according to this reasoning it is easy to understand why a package depicting sugar cubes is the one that raises the highest sweetness expectations (it both depicts a large amount of sugar and also fosters the cognitive access to the concept of 'Sweet' by presenting it in an everyday and coherent format within this context) and why the other two images raise similar expectations, both of them lower than that of the sugar cubes image, since each image relates to only one of these reasons (the package with the image of a sack shows a big amount of sugar but does not fit with the mental representation of adding sugar to the product, and the opposite is true for the package with the image of a spoon of sugar).

Regarding the non-sensory attributes, the results show that the image of a sack of sugar is more easily associated with the attribute Natural Ingredients than the rest of the images. The consumer associates a sack of sugar with the concept of natural ingredients since it activates associations with concepts like farm, field or nature, which are not closely connected with the mental representation of the industrial process (Chae and Hoegg, 2013). This assumption lines up with other earlier studies which suggest that stereotypical information associated with food shapes perception (Brierley and Elliott, 2015) and is endorsed by the findings obtained from the Word Association task in which the packaging depicting a sugar sack is the one that is more frequently associated with the term 'Nature'. In contrast, consumers do not associate nor the image of the sugar cubes nor the image of the sugar spoon with the concept of natural ingredients because neither of the two images is easily associated with concepts related to nature, since in both cases the sugar is represented fully processed and ready for consumption. Additionally, the attributes Quality and Healthy have a positive correlation with the attribute Natural Ingredients, which coincides with the studies interrelated in this respect where it is suggested that consumers see products as healthier and of a higher

quality in case they have a high proportion of natural ingredients (Sütterlin and Siegrist, 2015; Machiels and Karnal, 2016; Román et al., 2017).

Finally, as for willingness to buy the results also confirm the earlier findings in the literature and show that there is a strong positive association link between willingness to buy and such attributes as Natural Ingredients, Healthy, and Quality (Fernqvist and Ekelund, 2014; Román et al., 2017). This implies that the higher consumer expectations are of whether the product is natural, of high quality and is made with natural ingredients, the higher their willingness to buy is (Machiels and Karnal, 2016; Román et al., 2017). However, it is worth noting that despite previous works argue that showing an image have a positive effect in consumers' attitude towards the product (Underwood and Klein, 2002) the results of this study suggest that it depends on what is depicted on the image: the participants showed less willingness to buy the package that showed sugar cubes than the one that only had text. As it has been argued, this may be explained by the fact that the sugar cubes image depicts a large amount of sugar and favors an easy accessibility to the 'Sugar' concept, thus giving much prominence to the concept 'Sweet'. Interestingly, the results of the multidimensional scaling show that willingness to buy does not have a strong association with the expectations of sweetness, although it does show a certain negative trend. In addition, the Word Association results show that there is a strong negative association between sweet and healthy, which seems to indicate that consumers do not relate expectations of the sweetness of the yogurt to their willingness to buy directly, yet indirectly they do through the attribute Healthy. In other words, consumers seem to quickly associate the concepts of sweetness with unhealthiness and consequently unhealthiness with low willingness to buy (Lustig et al., 2012).

445 Taken together, these results broaden and add more nuances to those of Rebollar et al.
446 (2017) since they show that conveying a secondary message (in this case, that yogurt is
447 sweetened) using a visual or verbal cue affects the consumer in a more complex way
448 than it used to be believed. Whereas their findings show that using an image enhances
449 expectations and willingness to buy, this research suggests that it depends on, firstly, the
450 concrete image chosen to be shown on the package and, secondly, on the type of
451 message to be conveyed. Conveying a message by means of an image provides it with
452 more relevance than doing so through a text because it captures attention more quickly
453 and is processed sooner (Underwood and Klein, 2002; Venter et al., 2011; Honea and
454 Horsky, 2012) Therefore, if the message to be conveyed is not clearly positive (like in
455 this case, since many consumers associate sweetness with diseases like obesity, Lustig
456 et al., 2012), providing too much relevance to it by means of a visual cue may end up
457 being counterproductive and detrimental to consumer expectations and willingness to
458 buy. This posits a challenge for designers and producers since they have to come up
459 with an engaging and effective way to convey the message that the product is sweetened
460 and yet not to give it too much relevance in order to not to prejudice willingness to buy.

461 Regarding the limitations of this research, it should be noted that the results obtained
462 may have been influenced by visual factors that have not been taken into account, such
463 as the size of the image or the aesthetics of the composition. As for the visual design,
464 the use of graphic elements such as images of the cow or a natural environment may
465 have biased the results increasing the accessibility to some concepts over others, but
466 since they were shown in all the stimuli, their possible effects were thus canceled.
467 Moreover, part of this study was conducted using an online survey on social media
468 meaning that the participants therein came only from that environment. Consequently,
469 there are limitations regarding the participants' diversity and characteristics. It would be

interesting to carry out further testing to see if the obtained results can be extrapolated to other countries, since all the participants were Spanish.

As an idea for a future research, it might be interesting to conduct a tasting in order to investigate what minimum amount of added sugar shall be considered by the participants to be excessively sweet and to assess if these effects also influence taste perception and willingness to buy. It would also be relevant to analyze in depth the possible existence of mediation (indirect effect) of the attribute Sweet with willingness to buy through the attribute Healthy, as the findings of this study seem to show. We believe that another interesting line of investigation should be directed at studying how the results obtained might be affected by the individual differences of the participants regarding health consciousness, since earlier studies suggest that the knowledge and beliefs of the consumer influence food acceptance (Verbeke, 2005; Karnal et al., 2016).

CONCLUSIONS

The results of this research suggest that the image shown on the package to convey that a yogurt is sweetened makes an impact on consumer sensory and non-sensory expectations and willingness to buy. Specifically, the results show that conveying that the yogurt is sweetened through both visual and verbal cues (i.e. both images and text) increases consumer expectations of sweetness and also that what is depicted on the image also has an effect on consumer perception and behavior. The package depicting sugar cubes raises the highest sweetness expectations, partly due to the amount of sugar depicted and partly because of how easily it is associated with the everyday action of adding sugar to the product, thus raising the accessibility to the sweet concept in consumers' mind. In addition, the attributes Healthy, Quality and Natural Ingredients have a strong positive association with willingness to buy and the attribute Sweet has a

strong negative association with the attribute Healthy, which indirectly seems to create a negative association with willingness to buy. The image of a sugar sack makes the expectations of the attribute Natural Ingredients be the highest of all the images, which implies that it also has higher willingness to buy. Despite the notion that defend that showing images in packaging improves the willingness to buy and the attitude of the consumer towards the product, the results of this study show that a poor image selection may be worse than showing not image at all, given that willingness to buy is not always improved if an image is shown. On the contrary, an adequate image choice may favor willingness to buy the product. This therefore implies that yogurt producers and packaging designers must find a balance in which they communicate that the natural yogurt is sweetened without giving too much prominence to that idea. In this regard, the image of a sack of sugar has proven to be the best one to achieve this twin objective.

REFERENCES

Arboleda, A.M., and C. Arce-Lopera. 2015. Quantitative analysis of product categorization in soft drinks using bottle silhouettes. Food Qual. Prefer. 45:1–10. doi:10.1016/j.foodqual.2015.04.006.

Ares, G., B. Piqueras-Fiszman, P. Varela, R.M. Marco, A.M. López, and S. Fiszman. 2011. Food labels: Do consumers perceive what semiotics want to convey?. Food Qual. Prefer. 22:689–698. doi:10.1016/j.foodqual.2011.05.006.

Armstrong, D., A. Gosling, J. Weinman, and T. Martaeu. 1997. The place of inter-rater reliability in qualitative research: An empirical study. Sociology 31:1–6.

Becker, L., T.J.L. van Rompay, H.N.J. Schifferstein, and M. Galetzka. 2011. Tough package, strong taste: The influence of packaging design on taste impressions and product evaluations. Food Qual. Prefer. 22:17–23.

518 doi:10.1016/j.foodqual.2010.06.007.

519 BEDCA. 2018. Base de Datos Española de Composición de Alimentos. Accessed May
520 14, 2018. http://www.bedca.net/.

521 BOE. 2014. Real Decreto 271/2014, de 11 de abril, por el que se aprueba la Norma de
522 Calidad para el yogur o yoghourt 33154–33157.

523 Bone, P.F., and K.R. France. 2001. Package graphics and consumer product beliefs. J.
524 Bus. Psychol. 15:467–489. doi:10.1023/A:1007826818206.

525 Brierley, M., and C. Elliott. 2015. Nutritional components and children's interpretations
526 of packaged food. Int. J. Heal. Promot. Educ. 53:230–243.
527 doi:10.1080/14635240.2015.1010654.

528 Carroll, J.D., and J.-J. Chang. 1970. Analysis of individual differences in
529 multidimensional scaling via an n-way generalization of "Eckart-Young"
530 decomposition. Psychometrika 35:283–319. doi:10.1007/BF02310791.

531 Celhay, F., J. Boysselle, and J. Cohen. 2015. Food packages and communication
532 through typeface design: The exoticism of exotypes. Food Qual. Prefer. 39:167–
533 175. doi:10.1016/j.foodqual.2014.07.009.

534 Celhay, F., and H. Remaud. 2018. What does your wine label mean to consumers? A
535 semiotic investigation of Bordeaux wine visual codes. Food Qual. Prefer. 65:129–
536 145. doi:10.1016/j.foodqual.2017.10.020.

537 Chae, B., and J. Hoegg. 2013. The Future Looks "Right": Effects of the Horizontal
538 Location of Advertising Images on Product Attitude. J. Consum. Res. 40.

539 Donovan, S.M., and R. Shamir. 2014. Introduction to the yogurt in nutrition initiative
540 and the first global summit on the health effects of yogurt. Am. J. Clin. Nutr.
541 99:1209–1211. doi:10.3945/ajcn.113.073429.

542 Fernqvist, F., and L. Ekelund. 2014. Credence and the effect on consumer liking of food
543 - A review. Food Qual. Prefer. 32:340–353. doi:10.1016/j.foodqual.2013.10.005.

544 Gabriel, R.K. 1971. The biplot graphic display of matrices with application to principal
545 component analysis. Biometrika 58:453–467. doi:10.1093/biomet/58.3.453.

546 Galindo, P. 1986. An alternative for simultaneous representation: HJ-Biplot. Questiió
547 Quad. d'Estadística, Sist. Inform. i Investig. Oper. 10:13–23.

548 Glaser, B.G., and A.L. Strauss. 1967. The Discovery of Grounded Theory: Strategies
549 for Qualitative Research. Aldine, Chicago.

550 González, J., A. Barros-Loscertales, F. Pulvermüller, V. Meseguer, A. Sanjuán, V.
551 Belloch, and C. Ávila. 2006. Reading cinnamon activates olfactory brain regions.
552 Neuroimage 32:906–912. doi:10.1016/j.neuroimage.2006.03.037.

553 Guerrero, L., A. Claret, W. Verbeke, G. Enderli, S. Zakowska-Biemans, F.
554 Vanhonacker, S. Issanchou, M. Sajdakowska, B.S. Granli, L. Scalvedi, M. Contel,
555 and M. Hersleth. 2010. Perception of traditional food products in six European
556 regions using free word association. Food Qual. Prefer. 21:225–233.
557 doi:10.1016/j.foodqual.2009.06.003.

558 Honea, H., and S. Horsky. 2012. The power of plain: Intensifying product experience
559 with neutral aesthetic context. Mark. Lett. 23:223–235. doi:10.1007/s11002-011-
560 9149-y.

561 Horan, C.B. 1969. Multidimensional scaling: Combining observations when individuals
562 have different perceptual structures. Psychometrika 34:139–165.
563 doi:10.1007/BF02289341.

564 Karnal, N., C.J.A. Machiels, U.R. Orth, and R. Mai. 2016. Healthy by design, but only
565 when in focus: Communicating non-verbal health cues through symbolic meaning

566 in packaging. Food Qual. Prefer. 52:106–119. doi:10.1016/j.foodqual.2016.04.004.

567 Kauppinen-Räisänen, H., R.A. Owusu, and B. Abeeku Bamfo. 2012. Brand salience of
568 OTC pharmaceuticals through package appearance. Int. J. Pharm. Healthc. Mark.
569 6:230–249. doi:10.1108/17506121211259403.

570 Kruskal, J.B., and M. Wish. 1984. Multidimensional Scaling. Sage Publications,
571 Beverly Hills and London.

572 Laing, S., and M. Masoodian. 2016. A study of the influence of visual imagery on
573 graphic design ideation. Des. Stud. 45:187–209. doi:10.1016/j.destud.2016.04.002.

574 Leeuw, J., and W.J. Heiser. 1980. Multidimensional scaling with restrictions on the
575 configuration. P.R. Krishnaiah, ed. North-Holland, Amsterdam, the Netherlands.

576 Liao, L.X., A.M. Corsi, P. Chrysochou, and L. Lockshin. 2015. Emotional responses
577 towards food packaging: A joint application of self-report and physiological
578 measures of emotion. Food Qual. Prefer. 42:48–55.
579 doi:10.1016/j.foodqual.2015.01.009.

580 Loken, B. 2006. Consumer Psychology: Categorization, Inferences, Affect, and
581 Persuasion. Annu. Rev. Psychol. 57:453–485.
582 doi:10.1146/annurev.psych.57.102904.190136.

583 López-Miranda, J., F. Pérez-Jiménez, E. Ros, R. De Caterina, L. Badimón, M.I. Covas,
584 E. Escrich, J.M. Ordovás, F. Soriguer, R. Abiá, C. Alarcón de la Lastra, M.
585 Battino, D. Corella, J. Chamorro-Quirós, J. Delgado-Lista, D. Giugliano, K.
586 Esposito, R. Estruch, J.M. Fernandez-Real, J.J. Gaforio, C. La Vecchia, D. Lairon,
587 F. López-Segura, P. Mata, J.A. Menéndez, F.J. Muriana, J. Osada, D.B.
588 Panagiotakos, J.A. Paniagua, P. Pérez-Martinez, J. Perona, M.A. Peinado, M.
589 Pineda-Priego, H.E. Poulsen, J.L. Quiles, M.C. Ramírez-Tortosa, J. Ruano, L.

590 Serra-Majem, R. Solá, M. Solanas, V. Solfrizzi, R. de la Torre-Fornell, A.
591 Trichopoulou, M. Uceda, J.M. Villalba-Montoro, J.R. Villar-Ortiz, F. Visioli, and
592 N. Yiannakouris. 2010. Olive oil and health: Summary of the II international
593 conference on olive oil and health consensus report, Jaén and Córdoba (Spain)
594 2008. Nutr. Metab. Cardiovasc. Dis. 20:284–294.
595 doi:10.1016/j.numecd.2009.12.007.

596 Lustig, R.H., L.A. Schmidt, and C.D. Brindis. 2012. Public health: The toxic truth about
597 sugar. Nature 482:27–29. doi:10.1038/482027a.

598 Lynott, D., and L. Connell. 2010. Embodied conceptual combination. Front. Psychol.
599 1:1–14. doi:10.3389/fpsyg.2010.00212.

600 Machiels, C.J.A., and N. Karnal. 2016. See How Tasty it is? Effects of Symbolic Cues
601 on Product Evaluation and Taste. Food Qual. Prefer. 52:195–202.
602 doi:10.1016/j.foodqual.2016.04.014.

603 Madzharov, A. V., and L.G. Block. 2010. Effects of product unit image on consumption
604 of snack foods. J. Consum. Psychol. 20:398–409. doi:10.1016/j.jcps.2010.06.007.

605 Magnier, L., and J. Schoormans. 2017. How Do Packaging Material, Colour and
606 Environmental Claim Influence Package, Brand and Product Evaluations?. Packag.
607 Technol. Sci.. doi:10.1002/pts.2318.

608 MAPAMA. 2017. Informe del consumo de alimentación en España 2016. Madrid.

609 McQuarrie, E.F., and D.G. Mick. 2003. Visual and Verbal Rhetorical Figures under
610 Directed Processing versus Incidental Exposure to Advertising. J. Consum. Res.
611 29:579–587. doi:10.1086/346252.

612 McQuarrie, E.F., and B.J. Phillips. 2005. Indirect persuasion in advertising: How
613 consumers process metaphors presented in pictures and words. J. Advert. 34:7–20.

614 doi:10.1080/00913367.2005.10639188.

615 Mizutani, N., M. Okamoto, Y. Yamaguchi, Y. Kusakabe, I. Dan, and T. Yamanaka.
616 2010. Package images modulate flavor perception for orange juice. Food Qual.
617 Prefer. 21:867–872. doi:10.1016/j.foodqual.2010.05.010.

618 Mueller, S., L. Lockshin, and J.J. Louviere. 2009. What you see may not be what you
619 get: Asking consumers what matters may not reflect what they choose. Mark. Lett.
620 21:335–350. doi:10.1007/s11002-009-9098-x.

621 Nancarrow, C., L.T. Wright, and I. Brace. 1998. Gaining competitive advantage from
622 packaging and labelling in marketing communications. Br. Food J. 100:110–118.
623 doi:10.1108/00070709810204101.

624 Neyens, E., G. Aerts, and T. Smits. 2015. The impact of image-size manipulation and
625 sugar content on children's cereal consumption. Appetite 95:152–157.
626 doi:10.1016/j.appet.2015.07.003.

627 Piqueras-fiszman, B., G. Ares, and P. Varela. 2011. Semiotics and Perception : Do
628 Labels Convey the Same Messages To Older and Younger Consumers?. J. Sens.
629 Stud. 26:197–208. doi:10.1111/j.1745-459X.2011.00336.x.

630 Piqueras-Fiszman, B., and C. Spence. 2012. The weight of the bottle as a possible
631 extrinsic cue with which to estimate the price (and quality) of the wine? Observed
632 correlations. Food Qual. Prefer. 25:41–45. doi:10.1016/j.foodqual.2012.01.001.

633 Piqueras-Fiszman, B., and C. Spence. 2015. Sensory expectations based on product-
634 extrinsic food cues: An interdisciplinary review of the empirical evidence and
635 theoretical accounts. Food Qual. Prefer. 40:165–179.
636 doi:10.1016/j.foodqual.2014.09.013.

637 Piqueras-Fiszman, B., C. Velasco, A. Salgado-Montejo, and C. Spence. 2013. Using

combined eye tracking and word association in order to assess novel packaging solutions: A case study involving jam jars. Food Qual. Prefer. 28:328–338. doi:10.1016/j.foodqual.2012.10.006.

Rebollar, R., I. Gil, I. Lidón, J. Martín, M.J. Fernández, and S. Rivera. 2017. How material, visual and verbal cues on packaging influence consumer expectations and willingness to buy: The case of crisps (potato chips) in Spain. Food Res. Int. 99:239–246. doi:10.1016/j.foodres.2017.05.024.

Rebollar, R., I. Lidón, I. Gil, J. Martín, M.J. Fernández, and C.E. Riveres. 2016. The influence the serving suggestion displayed on soft chee[1] R. Rebollar, I. Lidón, I. Gil, J. Martín, M. J. Fernández, and C. E. Riveres, "The influence the serving suggestion displayed on soft cheese packaging has on consumer expectations and willingn. Food Qual. Prefer. 52:188–194. doi:10.1016/j.foodqual.2016.04.015.

Rebollar, R., I. Lidón, A. Serrano, J. Martín, and M.J. Fernández. 2012. Influence of chewing gum packaging design on consumer expectation and willingness to buy. An analysis of functional, sensory and experience attributes. Food Qual. Prefer. 24:162–170. doi:10.1016/j.foodqual.2011.10.011.

Roininen, K., A. Arvola, and L. Lähteenmäki. 2006. Exploring consumers' perceptions of local food with two different qualitative techniques: Laddering and word association. Food Qual. Prefer. 17:20–30. doi:10.1016/j.foodqual.2005.04.012.

Román, S., L.M. Sánchez-Siles, and M. Siegrist. 2017. The importance of food naturalness for consumers: Results of a systematic review. Trends Food Sci. Technol. 67:44–57. doi:10.1016/j.tifs.2017.06.010.

Rundh, B. 2005. The multi□faceted dimension of packaging. Marketing logistic or marketing tool?. Br. Food J. 107:670–684. doi:10.1108/00070700510615053.

662 Rundh, B. 2009. Packaging design: creating competitive advantage with product
663 packaging. Br. Food J. 111:988–1002. doi:10.1108/00070700910992880.

664 Rundh, B. 2013. Linking packaging to marketing: how packaging is influencing the
665 marketing strategy. Br. Food J. 115:1547–1563. doi:10.1108/BFJ-12-2011-0297.

666 Saint-Eve, A., H. Leclercq, S. Berthelo, B. Saulnier, W. Oettgen, and J. Delarue. 2016.
667 How much sugar do consumers add to plain yogurts? Insights from a study
668 examining French consumer behavior and self-reported habits. Appetite 99:277–
669 284. doi:10.1016/j.appet.2016.01.032.

670 Schiffman, S.S., M.L. Reynolds, and F.W. Young. 1981. Introduction to
671 Multidimensional Scaling. Academic Press, New York.

672 Schmitt, N. 1998. Quantifying word association responses: what is native-like?. System
673 26:389–401. doi:http://dx.doi.org/10.1016/S0346-251X(98)00019-0.

674 Sehrawet, M., and S.C. Kundu. 2007. Buying behaviour of rural and urban consumers
675 in India: the impact of packaging. Int. J. Consum. Stud. 31:630–638.
676 doi:10.1111/j.1470-6431.2007.00629.x.

677 Smith, V., D. Barratt, and H. Selsøe Sørensen. 2015. Do natural pictures mean natural
678 tastes? Assessing visual semantics experimentally. Cogn. Semiot. 8:53–86.
679 doi:10.1515/cogsem-2015-0001.

680 Spence, C. 2018. Background colour & its impact on food perception & behaviour.
681 Food Qual. Prefer. 68:156–166. doi:10.1016/j.foodqual.2018.02.012.

682 Sütterlin, B., and M. Siegrist. 2015. Simply adding the word “fruit” makes sugar
683 healthier: The misleading effect of symbolic information on the perceived
684 healthiness of food. Appetite 95:252–261. doi:10.1016/j.appet.2015.07.011.

685 Underwood, R.L., and N.M. Klein. 2002. Packaging as brand communication: Effects

of product pictures on consumer responses to the package and brand. J. Mark. Theory Pract. 10:58–68.

Velasco, C., A. Salgado-Montejo, F. Marmolejo-Ramos, and C. Spence. 2014. Predictive packaging design: Tasting shapes, typefaces, names, and sounds. Food Qual. Prefer. 34:88–95. doi:10.1016/j.foodqual.2013.12.005.

Velasco, C., A.T. Woods, O. Petit, A.D. Cheok, and C. Spence. 2016. Crossmodal correspondences between taste and shape, and their implications for product packaging: A review. Food Qual. Prefer. 52:17–26. doi:http://dx.doi.org/10.1016/j.foodqual.2016.03.005.

Venter, K., D. van der Merwe, H. de Beer, E. Kempen, and M. Bosman. 2011. Consumers' perceptions of food packaging: an exploratory investigation in Potchefstroom, South Africa. Int. J. Consum. Stud. 35:273–281. doi:10.1111/j.1470-6431.2010.00936.x.

Verbeke, W. 2005. Consumer acceptance of functional foods: Socio-demographic, cognitive and attitudinal determinants. Food Qual. Prefer. 16:45–57. doi:10.1016/j.foodqual.2004.01.001.

Vicente-Villardón, J.L. 2015. MULTBIPLOT: A Package for Multivariate Analysis Using Biplots. Accessed July 8, 2016. http://biplot.usal.es/ClassicalBiplot/index.html.

Table 1. Frequency of elicitations of terms for the four stimuli considered in the word association task

	Stimuli			
Category	Sugar cubes	Sugar spoon	Sugar sack	Only text
Natural Yogurt	22	18	21	20
Nature	14	16	17	15
Sugar	25	12	17	7
Cow	14	10	17	10
Sweet	12	5	12	4
Milky	5	9	8	9
Healthy	2	8	7	13
Yogurt	6	8	9	6
Fresh	6	5	5	8

Sugar sack

Sugar cubes

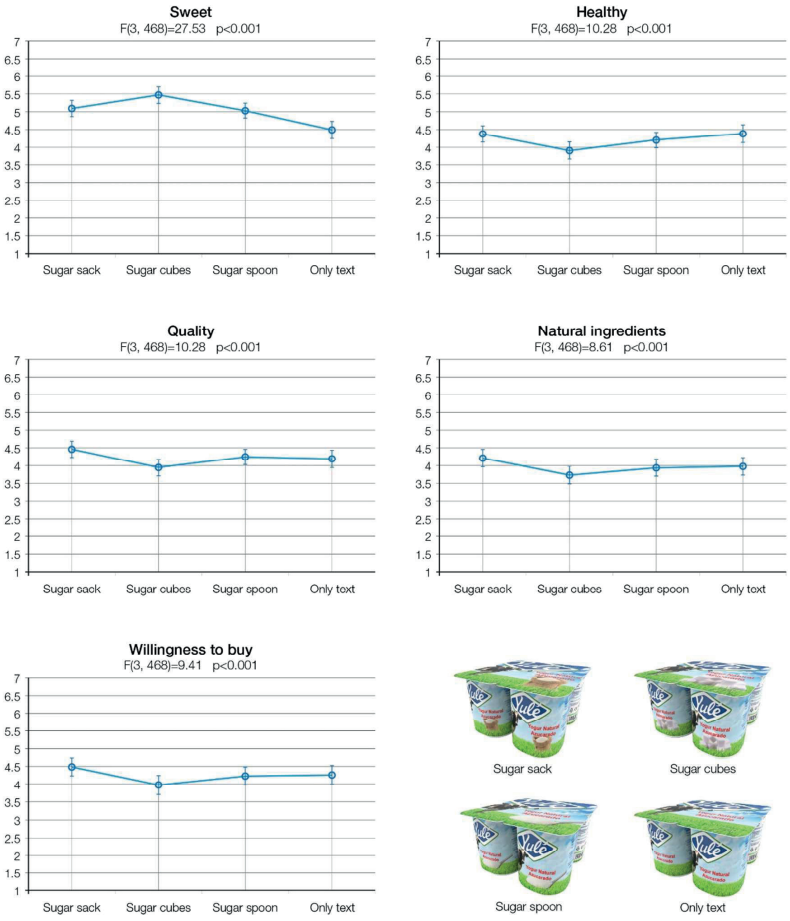
Sugar spoon

Only text

706

707 Rebollar Figure 1.

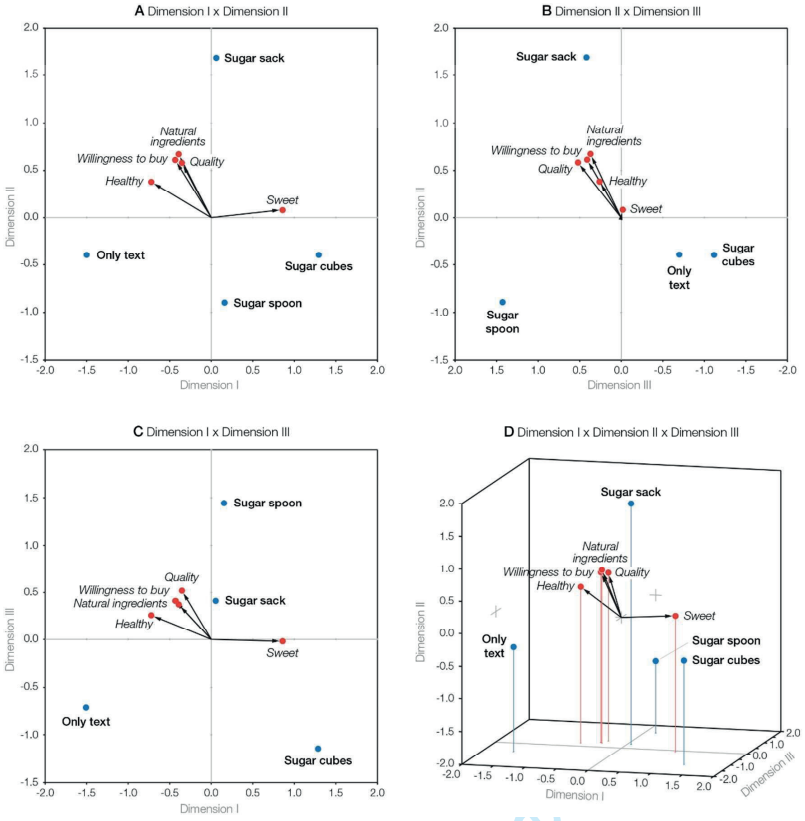
708 Visual stimuli used in the investigation.



709

710 Rebollar Figure 2.

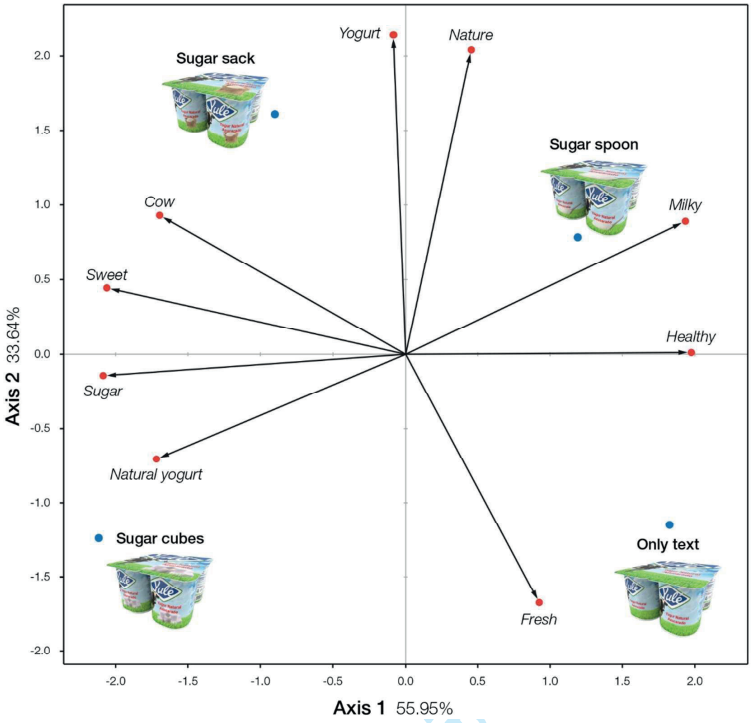
711 Results of the variance analysis.



712

713 Rebollar Figure 3.

714 Results of the multidimensional scaling.



715

716 Rebollar Figure 4.

717 Biplot graph of the Word Association task.

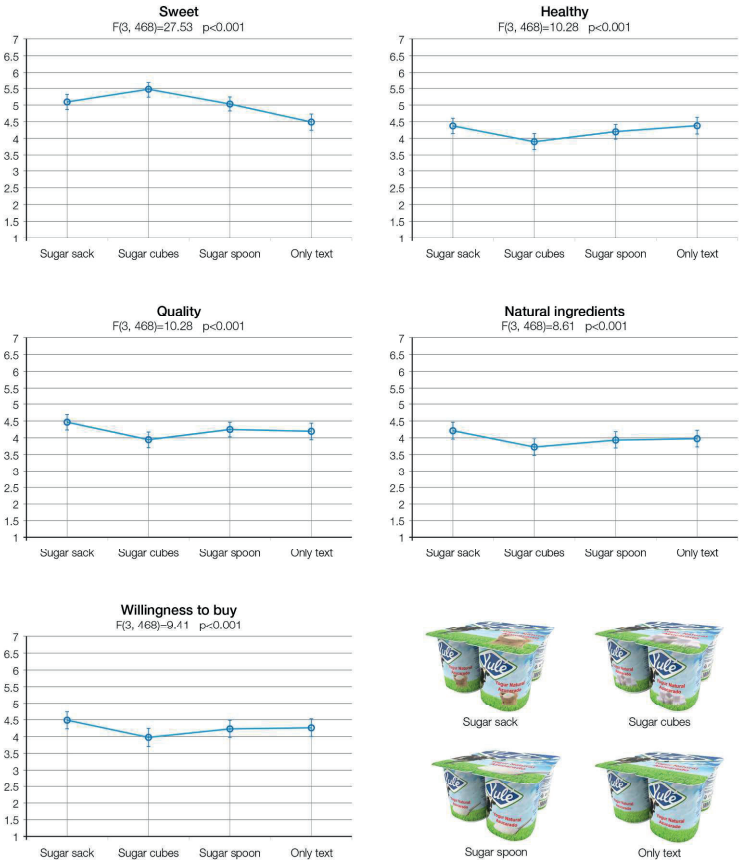
Sugar sack

Sugar cubes

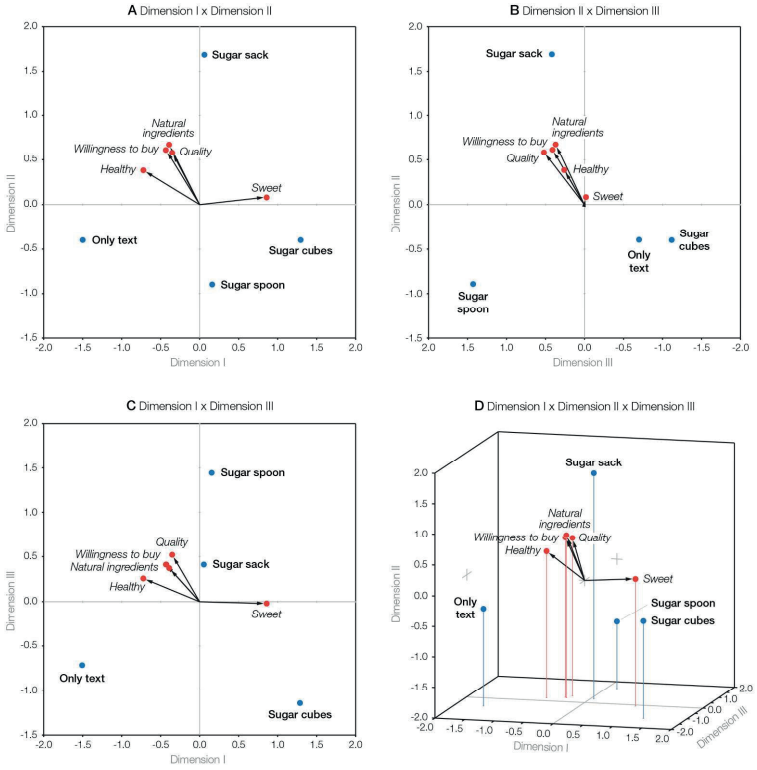
Sugar spoon

Only text

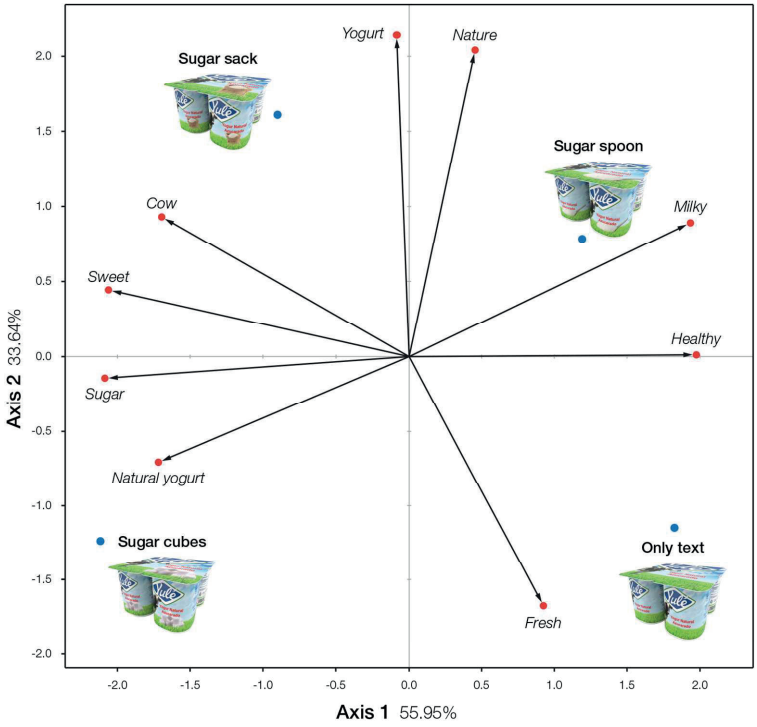
140x113mm (300 x 300 DPI)



189x215mm (300 x 300 DPI)



189x193mm (300 x 300 DPI)



140x134mm (300 x 300 DPI)

3.3. Study 3

Rebollar, R., Lidón, I., **Gil, I.**, Martín, J., Fernández, M. J., & Riveres, C. E. (2016). The influence the serving suggestion displayed on soft cheese packaging has on consumer expectations and willingness to buy. *Food Quality and Preference*, *52*, 188–194. https://doi.org/10.1016/j.foodqual.2016.04.015

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The influence the serving suggestion displayed on soft cheese packaging has on consumer expectations and willingness to buy

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ABSTRACT

This paper studies the influence that serving suggestions on a popular Spanish soft cheese – known as "*queso fresco*"—packaging have on consumer expectations regarding certain attributes of the product, its ideal consumption time during the day and the consumer's willingness to buy. Some 247 people participated in this investigation, evaluating 8 attributes and 5 possible consumption times of 5 different soft cheese packages with different accompaniments displayed on the serving suggestions. The results show that the consumer perceives the soft cheese to have the qualities and ideal consumption time based on the accompaniments shown in the serving suggestion. The study also shows that serving suggestion influences willingness to buy since there is a strong positive relationship between willingness to buy and accompaniments that are healthy and for special diets. These results have important implications for soft cheese producers, marketers, and packaging designers.

1. Introduction

Product packaging, in addition to protecting contents and enabling transport, handling and storage, serves to attract the attention of potential consumers, influencing their willingness to buy and even increasing product acceptance once purchased (Rundh, 2005). As Kauppinen-Räisänen (2014) state, packaging not only has the aim of containing the product, but also of promoting it, an idea that is supported by the fact that 70% of all buying decisions are made at the point of sale, even in the case of planned purchases (Inman, Winer, & Ferraro, 2013).

Food product packaging is therefore a priority sales tool for manufacturers; this is reflected in the fact that packaging design is the most important marketing task in the case of many products (Dickson, 1994). This is because outward appearance is a key for capturing the potential consumer's attention (Silayoi & Speece, 2007) and thus encouraging product purchase (Bloch, 1995; Fenko, Schifferstein, & Hekkert, 2010; Tuorila & Pangborn, 1988), since it has been proven to act as both a psychological and physical stimulus. (Reimann, Zaichkowsky, Neuhaus, Bender, & Weber, 2010).

Today many studies underscore the influence elements on food packaging have on potential buyers. It is known, for instance, that consumers are affected by product packaging shape (Becker, van Rompay, Schifferstein, & Galetzka, 2011; Rebollar, Lidón, Serrano, Martín, & Fernández, 2012), material (Mutsikiwa & Marumbwa, 2013), colour (Ares & Deliza, 2010; Mohebbi, 2014), labelling (Charters, Lockshin, & Unwin, 1999), labelling fonts (Orth, Campana, & Malkewitz, 2010) and even weight (Piqueras-Fiszman & Spence, 2012). However, the relationship between packaging and a potential consumer is not fully understood. This study therefore aims to go one step further by exploring how one of the most common food packaging design elements – the image on packaged product (especially when displayed as a serving suggestion) – influences consumer perception and expectations.

It is very common for food packaging to show the product inside through the use of transparent material or by placing one or more images on it. The influence this has on the consumer has already been studied. In this line, Deng and Srinivasan (2013) analysed how directly viewing the product inside the package via transparent materials affects the frequency of product consumption. Likewise, Underwood and Klein (2002) proved that including product images on packaging encourages consumers to view the products more positively.

Other studies go deeper into understanding this relationship by analysing the influence packaging images have on the consumer. Liao, Corsi, Chrysochou, and Lockshin (2015) studied the impact of images on packaging (regardless of whether these were of the product inside) on consumer emotional response; Bone and France (2001) observed the way these images affect willingness to buy and Mizutani et al. (2010) explored how they alter sensory

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perception of the product. Meanwhile, Madzharov and Block (2010) and Neyens, Aerts, and Smits (2015) demonstrated that the size of the image on the packaging affects the rate at which the product will be consumed once purchased.

Thus far, the researched conducted on images displayed on food packaging has tended to view them as a single element, focusing on their emotional character (Bone & France, 2001; Liao et al., 2015; Mizutani et al., 2010) or communicative character (Miraballes, Fiszman, Gámbaro, & Varela, 2014; Underwood & Klein, 2002; Underwood, Klein, & Burke, 2001). However, in practice, images on food packaging are often complex compositions in which several elements—other foods, people or props—are displayed. To date we have no evidence on research into how the other foods—those displayed as an accompaniment alongside the food product being sold—influence the consumer.

Manufacturers use other foods to accompany the main product on the package for several reasons. In some cases as a sensory metaphor – informing consumers about certain product characteristics, such as taste or smell – while others seeks to inform the consumer of the ingredients used to make the main product.

Likewise, by using packages displaying serving suggestions, the manufacturer displays the product ready for consumption, accompanied by other foods or props (usually dishes and/or cutlery), seeking to make the product more appetising and/or informing consumers about how and when can it be consumed.

Serving suggestions are a design tool widely used in food packaging. However there is little scientific literature on this topic. Some investigations have not included it within their study variables at all, considering packaging to be viewed as a given unit—meaning it is impossible to draw conclusions on the influence of its individual elements—(Grunert & Valli, 2001; Neyens et al., 2015) or because they did not consider its importance relative to others factors since it was not the aim of their research to study it (Mueller, Peschel, & Grebitus, 2013).

This paper seeks to fill the gap in this field detected by studying the influence of the elements on the serving suggestions—the accompaniments—not the product contents. The product studied was a Spanish soft cheese, since according to the Spanish Ministry of Agriculture, Food and Environment (MAGRAMA, 2015) this is the type of cheese with the highest consumption in Spanish households (29.9% of the total in 2013) and is purchased mainly in supermarkets and hypermarkets (for which the consumer is used to acquire the product ready packaged). This cheese is known as "*queso fresco*".

From among all the categories of soft cheese on the Spanish market, this study focuses on those obtained from pasteurized milk (sheep, goat, or cow): a soft white cheese, cylindrical conical or prismatic, without crust and with a soft texture. It is very common for this cheese packaging to show a serving suggestion with accompaniments.

In summary, this article aims to analyse the influence the foods used to accompany the cheese on the serving suggestion have on:

- Consumer expectations with respect to the attributes of the soft cheese,
- Consumer willingness to buy.
- The time of day consumers believe most suitable for its consumption.

2. Materials and methods

2.1. Participants

Some 247 people participated in this investigation—64% females (158) and 36% (89) males—all residing in Spain between October and November 2014. Their mean age was 27.7 years with a standard deviation of 10.4 years.

With regard to their educational profile, 80.16% of participants stated they had university qualifications, 18.62% stated they had qualifications from non-university institutions, and 1.21% said they had no professional qualifications.

With respect to the consumption of soft cheese, 21% stated they consumed it frequently, 45% answered from time to time, 24% said that they rarely ate it, and the remaining 10% admitted never having consumed soft cheese.

2.2. Procedure

The experiment was conducted via social media on a voluntary and anonymous basis, using an online survey tool to gather the data: SurveyMonkey®. Participants were not set a time limit to complete the survey or any particular section thereof. They were shown photorealistic renderings of five different soft cheese packages created for this investigation and given a questionnaire to evaluate them. All survey participants viewed the same packages displayed in a random order.

2.3. Stimuli

This experiment was designed with a total of five different packages in which the only variant was the foods shown in the serving suggestion, imitating the foods most commonly consumed with soft cheese: fruit (strawberry and kiwi), quince, salad (lettuce and cherry tomatoes) and sliced turkey, as well as one package displaying just the cheese. The packages used can be seen in Fig. 1.

The cheese was the central item in the composition on each package with an identical position and size, with the accompaniment to the left. The other variables were identical. The different packages were designed so that the space given to the accompaniment was similar on all the packages thus creating consistency in the relationship between both elements in all cases.

The package shape was inspired by the typical structure of a real package of four packs in a cardboard cover (the secondary package), since this is a typical format for this product. The graphic design of the secondary package mirrored the location and size of the different elements to make it as similar as possible to commercial packages. The image elements included the product description (the words "*Queso fresco*"), the brand (Torre Blanca – White Tower, in English – created especially for this investigation so that the participants could deduce certain attributes of the products based on prior experiences with other brands), the nutritional information (identical on all packages), the quantity of product contained (identical in all cases) and the serving suggestion. The five secondary packages were designed with a blue background colour since this is a neutral colour frequently used for this type of package.

The visual stimuli used in the survey were photorealistic renders created using Photoshop CS5 and Keyshot 4. The product photographs used on the package designs came from a set of ad hoc photographs taken of natural products.

2.4. Measurements

The survey was divided into three sections: control questions to identify the participants (age, gender, and education), the presentation of the packages to analyse—the visual stimuli in Fig. 1—and a survey relating to the study variable.

For each package, the survey evaluated a total of eight product attributes identified and chosen by a panel of experts, five possible consumption times during the day and willingness to buy. The list of attributes can be seen in Table 1.

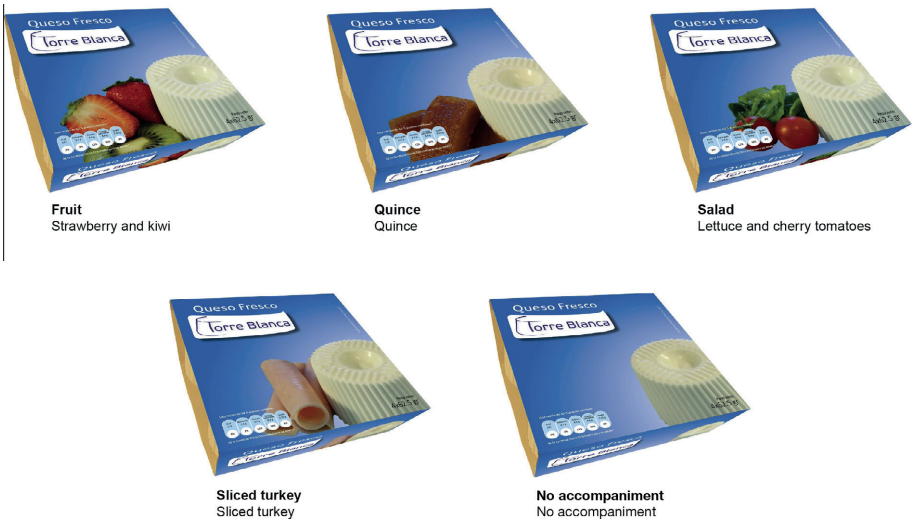

Fig. 1. Visual stimuli used in the investigation.

Table 1
List of product attributes used in the investigation.

Product attributes		Willingness to buy	Ideal time of consumption
Sensory	Non-sensory		
Sweet	Filling	Willingness to buy	Breakfast
Salty	Healthy		Lunch
Strong flavour	Low-Cal		Dinner
Compact/dense			In-between meals
Creamy			At any time

Participants were asked to evaluate the eight product attributes for each of the five packages according to a LIKERT scale of 1 (totally disagree) to 7 (totally agree), and to choose what time of day (from the five proposals) they deemed most suitable to consume each soft cheese. In both cases, participants were given the option of leaving the questionnaire blank for questions they did not know how to answer.

Willingness to buy was evaluated using the same scale of 1 (would not buy under any circumstances) to 7 (would be totally willing to buy). It was specified that all the products contained the same quantity of cheese and had the same cost, though the price wasn't specified.

2.5. Data analysis

Each attribute was individually analysed using one-way repeated measures analysis of variance (within-subjects ANOVA). For the comparisons of pairs following the analysis of variance, the Bonferroni penalty was used.

To study the preference of individuals with respect to the different packages, the Individual Differences Model was used (Carrol & Chang, 1970; Horan, 1969). This technique is included within multi-dimensional scaling techniques and has been used primarily to characterise variation in judged stimulus structure across individuals. This method is also known as INDSCAL. In this study, a matrix (5×5) of similarities between packages was calculated for each individual. These similarities were obtained from each individual score given to the different packages of soft cheese in relation to its sensory and non-sensory attributes. This technique allows the creation of a space of consensus for the individuals showing the similarities between the packages of soft cheese. In addition, it is possible to find out the weighting that each individual gave to the dimensions obtained in the consensus space. The weightings reflect the importance that the individuals associate to the dimensions in the stimuli space. Although one person can perceive one of the dimensions to be more important than the other, another person can have the opposite perception.

This technique was used with the attributes (sensory and non-sensory), as well as with willingness to buy. The analysis was conducted using the PROXCAL algorithm (Leeuw & Heiser, 1980), and Euclidian distance was used as a measure of similarity. The criterion to choose the number of dimensions in the consensus space was based on goodness of fit and the number of stimuli included in the analysis. S-Stress was used to determine goodness of fit. If this measurement is low, it indicates that the configuration obtained in the map (or space) is good. Kruskal and Wish (1984) deem the solution to be acceptable when the S-Stress values are less than 0.1. For this technique, these authors suggest the relationship between the number of stimuli and the number of dimensions, stating that up to 12 stimuli can be represented in two dimensions.

The vector model (Schiffman, Reynolds, & Young, 1981) was used to interpret the dimensions of preference in accordance with the observable attributes. This procedure uses the multiple regression technique to determine the direction of the attributes. The means of the individual scores of attributes are used to calculate the multiple regression, and the standardized regression coefficients (β_1, β_2) are computed and drawn as coordinates in the two-dimensional stimulus plane. Finally, a line is drawn through the origin of the stimulus consensus space and through coordinates defined by the regression coefficients. This model helps to interpret the dimensions of the space of similarities using the attributes forming the similarities among the stimuli. Moreover, the attribute-vector is shown as a line in the space representing the

packages of soft cheese in which the projection of each stimulus corresponds to the level of attributes possessed by that stimuli. If the attribute in question is strongly related with the stimuli space, then the projections of the stimuli will coincide very closely with the value of the attribute and the correlation between the projection and the attribute will be quite high. When two attributes are facing in the same direction, this also indicates a high correlation. When the points that represent the vector are close to a dimension and far from the centre, these are important to explain that dimension. If an attribute is in a position halfway between two dimensions, this indicates that the attribute is explained in both dimensions. If a vector-attribute is close to the centre of the stimuli space, this means that it is insignificant in the explanation of the dimensions of that space. This model allowed the packages to be ordered according to each of the attributes evaluated by the subjects. It also made it possible to determine which attributes had a high correlation in the stimuli evaluation. Subjects' willingness to buy was included as an external value to explore the dimension with the highest correlation.

Chi-square in contingency tables was used to analyse the association between the time of consumption and the packaging type. Correspondence analysis (Greenacre, 2007) was used to interpret the causes of association. This analysis enabled the exploration of which combination of categories of the consumption time variable and package type variable were responsible for the association between said variables. Using this technique, the categories of both variables can be represented in a low dimension space and the association via the representation axes can be examined.

The data was processed using SPSS (version 21).

3. Results

3.1. Influence of serving suggestion on consumer expectations and their willingness to buy the product

All the results obtained using the variance technique analysis gave statistically significant values both with regard to the eight attributes tested as well as willingness to buy the product. The results of the nine analyses can be seen in Fig. 2.

The packages displaying the greatest different in the results were those with the attributes *Sweet* and *Salty*.

In the case of the attribute *Sweet*, there is a marked difference between the accompaniments of fruit and quince with respect to the others, with the soft cheese accompanied with quince obtaining the higher mean value (4.88), and the cheese accompanied with turkey and the salad obtaining the lowest mean values (2.57 each).

On the other hand, in the case of the *Salty* attribute, there is a clear difference between the salad and the turkey slice accompaniments with both of these obtaining higher values; the turkey slices obtained the highest value (4.60) and the quince the lowest (2.64).

The results relating to the two non-sensory attributes, *Healthy* and *Low-Cal*, also have a marked difference between their extreme values. Both attributes obtain structurally similar results, with the quince accompaniment obtaining the lowest results in both cases and the salad accompaniment obtaining the highest results.

The results for Willingness to buy show that the package obtaining the highest value was the one with the salad accompaniment, and the one with the lowest value was the one with the quince accompaniment.

The attributes *Strong Flavour*, *Compact/dense*, *Creamy* and *Filling* display differences between the different values, but these differences are lower than the ones mentioned above.

The consensus plane obtained by the multidimensional analysis (Fig. 3) shows similarities among the stimuli. The dimensionality chosen for the multidimensional scaling solution was two dimensions (S-Stress = 0.101). The first dimension differentiates the packages of quince and fruit from the rest. Axes two differentiates the packages of fruit and salad (lower part) from the others (higher part). An analysis of the layout of the packages in relation to the attributes included via the vectorial model shows that the attributes *Sweet* and *Salty* are closely associated to Dimension I and much less related to Dimension II, while the attribute *Creamy* shows the exact opposite. The attributes *Low-Cal*, *Healthy* and, most of all, *Willingness to buy* are equally associated to the two dimensions. *Strong Flavour*, *Filling and Compact/dense* display weak associations with both dimensions.

It can be seen how *Willingness to Buy* has a strong positive relationship to the attributes *Low-Cal* and *Healthy* and how, on the other hand, there is a strong negative relationship between *Willingness to buy* and the attribute *Compact/Dense*.

The attributes *Creamy*, *Intense flavour and Filling* display a weaker relationship with *Willingness to buy*.

Dimension I is defined by the sweet-salty gradient, and, to a lesser extent, by the attributes *Low-Cal*, *Healthy* and *Willingness to buy*, with a greater direct association with the *Salty* attribute and inverse association with the attribute *Sweet*. Dimension II is defined by the attributes *Strong Flavour* and *Creamy*. The attribute *Willingness to buy* is explained by both dimensions.

In the analysis of individuals' weightings, it can be seen that 84.6% gave similar importance to dimensions I and II, compared to 13.4% who gave most importance to dimension I. Only 2% of individuals rated only dimension II. Thus most individuals weighted both dimensions equally.

3.2. Influence of serving suggestion on time of consumption

To analyse the influence of serving suggestion on the ideal time of day for consumption, a correspondence analysis was conducted (Fig. 4). The Chi-square association was significant ($\chi^2 = 345$, p-value < 0.0001).

The images show that the cheese without accompaniment is clearly associated with consumption at *Any time of the day*.

The package with the salad accompaniment is related with being consumed at *Lunchtime*, and the fruit package with the time of the day *In-between meals*, whereas the quince package was equally associated with the *Breakfast* and *In-between meals* times of consumption.

None of the packages were clearly associated with consumption at *Dinner* time.

4. Discussion

This investigation sought to provide information on how the serving suggestion on a food package influences its potential consumption, aiming to fill a gap in the literature thus far.

With respect to the objectives of this investigation, the results demonstrate that indeed the serving suggestion influences the consumer's expectations about the soft cheese, since the consumer attributes it with the qualities and the characteristics of the accompaniment shown on the serving suggestion.

Thus it can be seen how the cheese contained in the packages using sweet accompaniments were perceived to be sweeter (as in the case of the quince) and those using more salty accompaniments were perceived to be more salty (such as the salad and the turkey slices).

In the results relating to the time of consumption, the same type of association can be seen. The package with the quince accompaniment has an important relationship with *Breakfast* time and *In-between meals*, which are the times during which it is

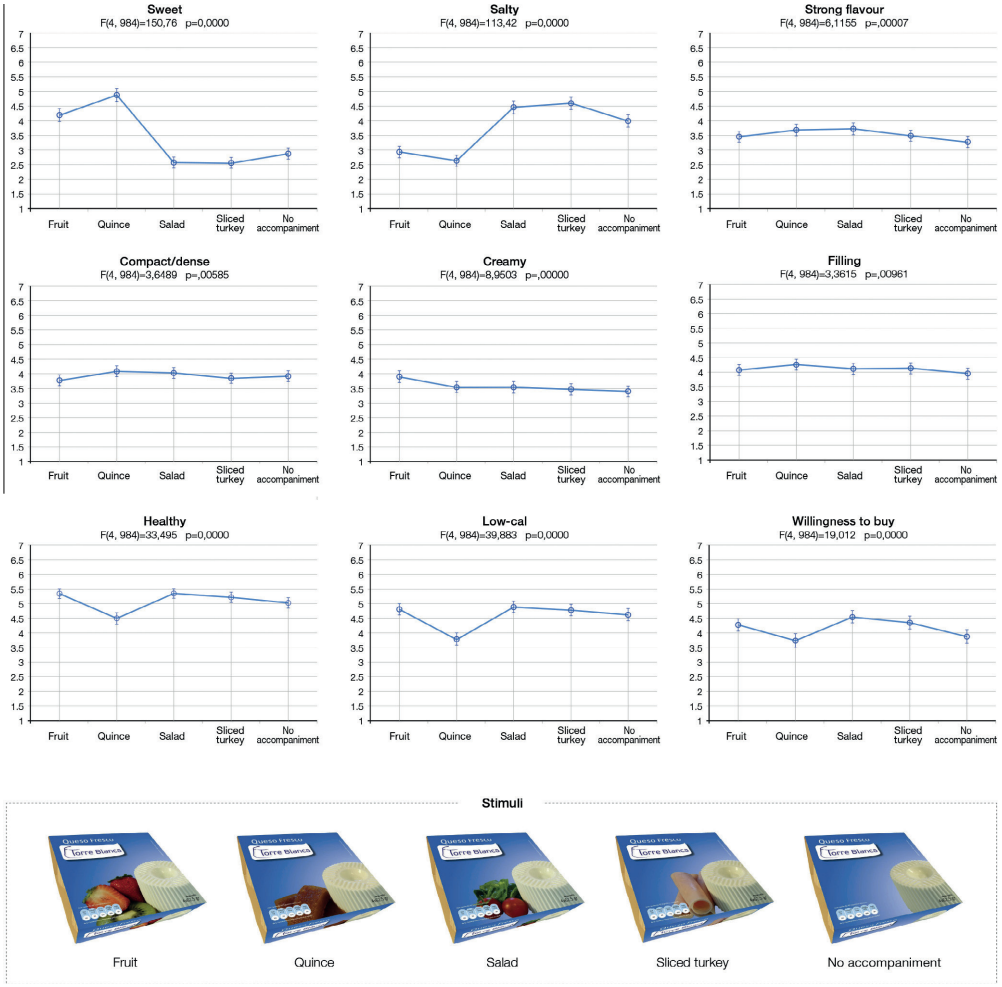

Fig. 2. Results of the variance analysis.

normally consumed, and how the absence of an accompaniment influences its consumption at any time, thus meaning it is not associated with any specific time of day.

The results show that the serving suggestion on the packages also influences willingness to buy since it has a strong positive relationship with consumer perception of the product attributes of *Healthy* and *Low-Cal*. Therefore the accompaniment displayed together with the cheese has an importance above and beyond there mere aesthetics, a finding that is very important for manufacturers, marketers and designers alike. Choosing a food perceived as healthy for the serving suggestion may encourage willingness to buy, whereas choosing a food perceived to be not very healthy may imply the opposite.

The results show how using an accompaniment to accompany the cheese on the serving suggestion does not always increase willingness to buy, since willingness to buy is higher for the package without accompaniment than the package with the quince accompaniment, which is perceived as not very healthy.

The results also show a clear relationship between the attributes of *Low-Cal* and *Healthy*, with both obtaining structurally similar results, though the results for the attribute *Low-Cal* were slightly lower (with a more marked difference when accompanied with a quince accompaniment). This can be explained by the distinction the consumer makes between healthy foods and low-cal foods: a specific food, such as olive oil, may be healthy, but not low-cal.

In addition to all the variables analysed in this investigation, there are, however, other factors not taken into account which may come into play to influence the results, for example, the size ratio between the accompaniments and the cheese, the quantity of accompaniment displayed, the shape of the presentation of both the accompaniment and the cheese, or the aesthetics of the composition.

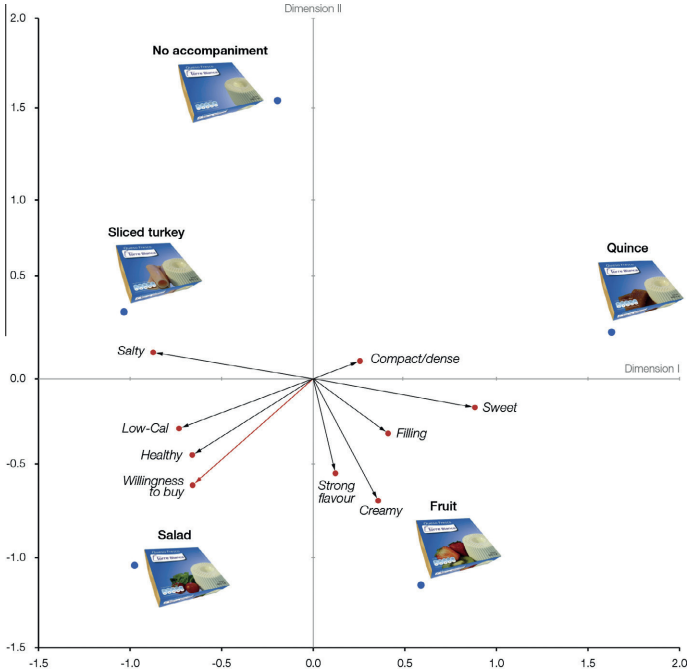

Fig. 3. Results of the multidimensional scaling.

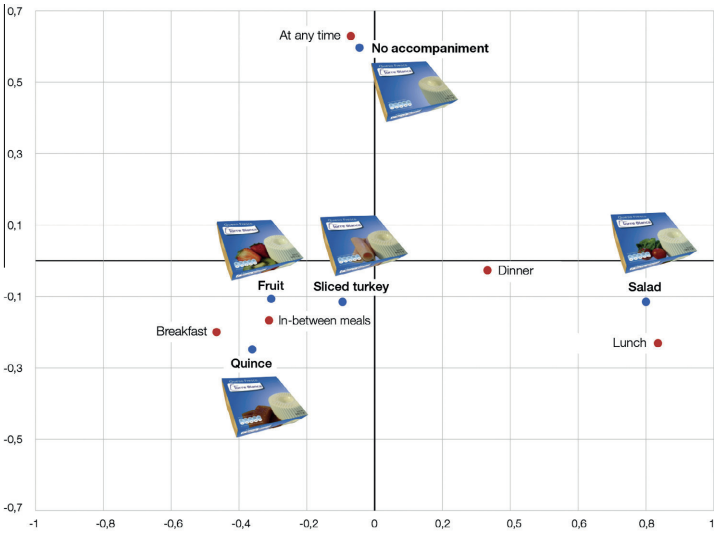

Fig. 4. Two-dimensional display from Correspondence Analysis. The two factor accounts for 89% of total inertia.

Likewise, though this investigation studied an important design feature on food packages, the absence of an analysis of other important variables, such as price or flavour, is indeed a limitation.

The similarity of some characteristics on the packages used in this investigation with real-life brands, such as the format or colour, may have influenced the evaluation of certain attributes since participants' prior experiences and sensations with products they had previously consumed may have influenced their reactions to the stimuli.

Nevertheless, in order to try to avoid such interference, a neutral design was used in which the other variables – such as the company name, the brand and the image shown – differed greatly from real-life brands.

Unlike other studies, such as (Becker et al., 2011), this investigation did not include a taster sample of the cheese. A test of such characteristics could prove highly valuable to enrich the findings of this investigation and to explore whether the expectations generated by the package are confirmed by sampling the product, particularly in the case of the sensorial attributes. However this experiment focused only on the visual perception of the secondary packaging since in the moment of purchase the consumer does not have access to the product, only to the secondary packaging.

As explained earlier, this study was conducted using an online survey via social media meaning that the participants therein were sourced only from this environment. Consequently there are limitations with respect to the participants' diversity and characteristics. All the participants were residing in the same country (Spain), meaning that further testing would be needed to see if these results can be extrapolated to other markets.

This study analysed possible relationships between the consumption of soft cheese and participants' age and gender in relation to the attributes selected for the study. No statistically important relationships were identified.

Future investigations along this line could include other design variables, such as the adding other elements to the serving suggestion—plates and utensils—and varying the presentation of the accompaniment or the main product—different cuts, mixture—or the quantity of the products displayed.

5. Conclusions

The results of this investigation show that the serving suggestion on product packages has an influence on consumer expectations of the attributes and characteristics of the product packaged, such as its ideal time of consumption. The consumer attributes the product with the qualities and the characteristics of the accompaniment in the serving suggestions. A relationship was found between the perception of the attributes *Healthy* and *Low-Cal* and *Willingness to buy* the product, since the packages displaying the soft cheese with a serving suggestion perceived to be healthy and low-cal obtained greater scores in participants' willingness to buy the product. Similarly, the consumer deduces the ideal time to consume the product in accordance with the food displayed in the serving suggestion, showing a need to carefully select the accompaniment displayed on the serving suggestion to maximise willingness to buy.

References

Ares, G., & Deliza, R. (2010). Studying the influence of package shape and colour on consumer expectations of milk desserts using word association and conjoint analysis. *Food Quality and Preference, 21*, 930–937.

Becker, L., van Rompay, T. J. L., Schifferstein, H. N. J., & Galetzka, M. (2011). Tough package, strong taste: The influence of packaging design on taste impressions and product evaluations. *Food Quality and Preference, 22*, 17–23.

Bloch, P. H. (1995). Seeking the ideal form: Product design and consumer response. *Journal of Marketing, 59*(3), 16–29.

Bone, P. F., & France, K. R. (2001). Package graphics and consumer product beliefs. *Journal of Business and Psychology, 15*(3), 467–489.

Carrol, D. J., & Chang, J. J. (1970). Analysis of individual differences in multidimensional scaling via an n-way generalization of "Eckart–Young" decomposition. *Psychometrika, 35*, 283–319.

Charters, S., Lockshin, L., & Unwin, T. (1999). Consumer responses to wine bottle back labels. *Journal of Wine Research, 10*, 183–195.

Deng, X., & Srinivasan, R. (2013). When do transparent packages increase (or decrease) food consumption? *Journal of Marketing, 77*(5), 104–117.

Dickson, P. R. (1994). *Marketing management*.Austin: The Dryden Press.

Fenko, A., Schifferstein, H. N. J., & Hekkert, P. (2010). Shifts in sensory dominance between various stages of user-product interactions. *Applied Ergonomics, 41*, 34–40.

Greenacre, M. (2007). *Correspondence analysis in practice*. CRC Press.

Grunert, K. G., & Valli, C. (2001). Designer-made meat and dairy products: consumer-led product development. *Livestock Production Science, 72*(1–2), 83–98.

Horan, C. B. (1969). Multidimensional scaling: Combining observations when individuals have different perceptual structures. *Psychometrika, 34*, 139–165.

Inman, J. J., Winer, R. S., & Ferraro, R. (2013). The interplay among category characteristics, customer characteristics, and customer activities on in-store decision making. *Journal of Marketing, 73*(5), 19–29.

Kauppinen-Räisänen, H. (2014). Strategic use of colour in brand packaging. *Packaging Technology and Science, 27*(8), 663–676.

Kruskal, J. B., & Wish, M. (1984). *Multidimensional scaling*. Beverly Hills and London: Sage Publications.

Leeuw, J., & Heiser, W. J. (1980). Multidimensional scaling with restrictions on the configuration. In P. R. Krishnaiah (Ed.). *Multivariate analysis* (vol. V, pp. 501–522). Amsterdam, the Netherlands: North-Holland.

Liao, L. X., Corsi, A. M., Chrysochou, P., & Lockshin, L. (2015). Emotional responses towards food packaging: A joint application of self-report and physiological measures of emotion. *Food Quality and Preference, 42*, 48–55.

Madzharov, A. V., & Block, L. G. (2010). Effects of product unit image on consumption of snack foods. *Journal of Consumer Psychology, 20*(4), 398–409.

MAGRAMA, (n.d.). Retrieved December 2, 2015, from <http://www.magrama.gob.es/es/alimentacion/temas/consumo-y-comercializacion-y-distribucion-alimentaria/panel-de-consumo-alimentario/base-de-datos-de-consumo-en-hogares/consulta11.asp>.

Miraballes, M., Fiszman, S., Gámbaro, A., & Varela, P. (2014). Consumer perceptions of satiating and meal replacement bars, built up from cues in packaging information, health claims and nutritional claims. *Food Research International, 64*, 456–464.

Mizutani, N., Okamoto, M., Yamaguchi, Y., Kusakabe, Y., Dan, I., & Yamanaka, T. (2010). Package images modulate flavor perception for orange juice. *Food Quality and Preference, 21*(7), 867–872.

Mohebbi, B. (2014). The art of packaging: An investigation into the role of color in packaging, marketing, and branding. *International Journal of Organizational Leadership, 3*, 92–102.

Mueller, S., Peschel, A., & Grebitus, C. (2013). Quantifying effects of convenience and product packaging on consumer preferences and market share of seafood products: The case of oysters. *Food Quality and Preference, 28*(2), 492–504.

Mutsikiwa, M., & Marumbwa, J. (2013). The impact of aesthetics package design elements on consumer purchase decisions: A case of locally produced dairy products. *Journal of Business and Management (IOSR-JBM), 8*(5), 64–71.

Neyens, E., Aerts, G., & Smits, T. (2015). The impact of image-size manipulation and sugar content on children's cereal consumption. *Appetite, 95*, 152–157.

Orth, U. R., Campana, D., & Malkewitz, K. (2010). Formation of consumer price expectation based on package design: Attractive and quality routes. *The Journal of Marketing Theory and Practice, 18*(1), 23–40.

Piqueras-Fiszman, B., & Spence, C. (2012). The weight of the container influences expected satiety, perceived density, and subsequent expected fullness. *Appetite, 58*(2), 559–562.

Rebollar, R., Lidón, I., Serrano, A., Martín, J., & Fernández, M. J. (2012). Influence of chewing gum packaging design on consumer expectation and willingness to buy. An analysis of functional, sensory and experience attributes. *Food Quality and Preference, 24*, 162–170.

Reimann, M., Zaichkowsky, J., Neuhaus, C., Bender, T., & Weber, B. (2010). Aesthetic package design: A behavioral, neural, and psychological investigation. *Journal of Consumer Psychology, 20*(4), 431–441.

Rundh, B. (2005). The multi-faceted dimension of packaging. Marketing logistic or marketing tool? *British Food Journal, 107*(9), 670–684.

Schiffman, S. S., Reynolds, M. L., & Young, F. W. (1981). Introduction to Multidimensional Scaling. In *Theory, Methods and Applications*. New York: Academic Press.

Silayoi, P., & Speece, M. (2007). The importance of packaging attributes: A conjoint analysis approach. *European Journal of Marketing, 41*(11), 1495–1517.

Tuorila, H., & Pangborn, R. M. (1988). Prediction of reported consumption of selected fat-containing foods. *Appetite, 11*(2), 81–95.

Underwood, R. L., & Klein, N. M. (2002). Packaging as brand communication: Effects of product pictures on consumer responses to the package and brand. *Journal of Marketing Theory and Practice, 10*(4), 58–68.

Underwood, R. L., Klein, N. M., & Burke, R. R. (2001). Packaging communication: attentional effects of product imagery. *Journal of Product & Brand Management, 10*(7), 403–422.

3.4. Study 4

Lidón, I., Rebollar, R., **Gil-Pérez, I.**, Martín, J., & Vicente-Villardón, J. L. (in press). The influence the image of the product shown on food packaging labels has on product perception during tasting: Effects and gender differences. *Packaging Technology and Science*. https://doi.org/10.1002/pts.2407

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RESEARCH ARTICLE

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The influence the image of the product shown on food packaging labels has on product perception during tasting: Effects and gender differences

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Many food packages on the market show an image of the product contained inside or the ingredients with which the product was produced. During the packaging design process, it is the job of the designer or the marketing team to decide which specific image will be depicted on the packaging. This paper analyses the potential implications of this decision by studying the influence that the visual appearance of the product pictured on the packaging has on the way consumers perceive the product during consumption. Two packaging designs for apple sauce were created; the only variable was the visual appearance of the apple displayed: one showed a red apple and the other showed a green one. The 147 participants in this between-subjects experiment tasted and evaluated six product attributes (*Sweet*, *Acidic*, *Intense Flavour*, *Healthy*, *Natural*, and *Quality*) as well as *Liking* and *Willingness to buy*. The results of a MANOVA-Biplot analysis show that the visual appearance of the product pictured affects *Liking*, *Willingness to buy*, and some product attributes. In fact, a strong positive relationship was identified between the attribute *Healthy* and the perceived quality of the product with *Liking* and *Willingness to buy*; if one of these attributes scored higher, the higher score was extrapolated to the others. The study also shows that gender differences exist as these effects do not affect all consumers equally, with women being more sensitive to them than men. This paper discusses the implications of these results for the food industry, for packaging designers and for marketers.

KEYWORDS

food evaluation, packaging design, product acceptance, sensory science, visuals

1 | INTRODUCTION

The visuals on any packaging are a key communication element.[1,2] Earlier research conducted in this field shows that design decisions can have consequences that go beyond mere aesthetic acceptance, because the user's perception of the product can be affected by different elements and layouts.[3] Designers have many graphic elements—such as colours, typography, physical forms, and images—to use when composing packaging graphics. For example, colour is one of the most important graphic elements of a package because it allows highly customised designs and enables companies to easily differentiate their products from those of their competitors.[4,5] In fact, of all the graphic design elements on packaging, colour is quite possibly the one that triggers the fastest response,[6] and it also has a lasting effect on the consumer.[7] The consumer also uses colour to deduce the sensory characteristics of the product, such as taste or smell,[8-10] as well as its functional[11] or conceptual attributes.[12] The typography chosen for the texts on packaging can provide the consumer with information on the origin of the product,[13] its price range,[14] and how healthy it is.[15] The shape of the packaging can influence

consumers' sensory expectations of the product,[4] flavour perceived during tasting,[16] and even experiential expectations.[9]

However, of all the visual elements present on a product's packaging, the image depicted on the packaging is one of the features most frequently used by both designers and marketers. In fact, it is an element that is usually given a preferential space in the composition of the package or label for most of the products on the market.[17] The image pictured on a food package is an element of particular interest and importance within the visual elements.[18-20] The image displayed on a product's packaging also influences consumer beliefs about the brand[21] and helps to catch the attention of consumers.[22] Previous research has even studied its effect on the emotional response of consumers.[20] Moreover, it is an element with great scope for designers. A visit to any supermarket demonstrates that there are few products with no images on their packaging.[17] The motifs used vary greatly depending on the kind of product and the criteria used by the designer or marketing team. As such, a package may display a picture of the product contained inside, a picture of something more vaguely related to the product (eg, places, animals or people) or a combination of the two.

Showing the product contained in the packaging is particularly important because it allows the consumer to see the product's appearance. A product's appearance is a visual cue which consumers use to infer it with certain quality attributes.[17,23-25] Thus, seeing a food product allows consumers to more easily imagine its sensory attributes.[23] One of the first studies conducted in this field evaluated 24 alternative passion fruit juice packages that had been generated digitally.[4] One of the variables in the experiment was the image shown on the package; other variables were the background colour and the language used in the text. This study evaluated expectations regarding both sensory attributes (sweet, pure, intense, fresh) as well as non-sensory attributes (freshness, natural and acceptance). The study concluded that the image was an influential and significant variable in almost all the case studies and was particularly important for participants with low need for cognition, ie, those who tended to pay attention to the details.

In recent years, several studies have assessed the influence that the image displayed on a food product's packaging has on the generation of expectations[3,26,27] and on willingness to buy.[28] Rebollar et al[29] proved that the serving suggestion displayed on the package affects expectations and willingness to buy and that the consumer perceives the main product to have the qualities based on the accompaniments shown in the serving suggestion. Madzharov and Block[30] and Neyens, Aerts and Smits[31] demonstrated that certain image characteristics even influence how much of the product is consumed. These studies show that consumption may be higher when the number of product units displayed on the image is higher[30] and when the image occupies a larger portion of the label.[31] In a more recent paper, Rebollar et al[32] showed that the way in which crisps are depicted in the image on the package has an effect on consumer sensory expectations, which is reflected in their willingness to buy. The depiction of ready-to-eat crisps, when compared with a composition in which a raw potato is depicted, increased expectations of salty and crunchy attributes and predisposition to buy.

In contrast to the growing body of knowledge we have about how the image displayed on a package influences the generation of expectations, research on how that image influences consumer perception during tasting is scarce. This is particularly important for designers or producers of products which are intended to be consumed directly from their packages or with the package in sight (eg, soft drinks, jams, or crisps). Until now, research has mainly focused on how factors such as congruence,[33,34] valence (ie, pleasantness),[34] and the symbolic meaning of the image shown on the package[2] influence consumer perception during tasting. In one of the few studies conducted in this vein—published in its entirety only in Japanese, but summarized by Mizutani et al,—[34] Sakai[33] studied the effect of viewing an image of fruit while drinking fruit juice. This study analysed the influence of congruent combinations—eg, the effect of displaying an image of an orange when drinking orange juice—as well as incongruent combinations—eg, the effect of displaying an image of an apple when drinking orange juice—on consumers' sensory and hedonic evaluations. The findings showed that sensory attributes and palatability were higher for congruent combinations. Mizutani et al[34] undertook a more complex study in which participants drank orange juice from glasses on which an image had been placed. The images were designed to combine congruence factors (ie, orange or non-food images) and valence factors (ie, pleasant or unpleasant images). The results demonstrated that valence had a significant effect on palatability and the perceived freshness of juice, with higher scores for pleasant images. The study also found that congruence was significant for aroma, with the congruent images scoring higher in this variable. Interestingly, the study found that flavour intensity was unaffected by image congruence or valence. More recently, in a study conducted by Machiels and Karnal,[2] participants drank a glass of orange juice while viewing an advert showing its commercial packaging. The stimuli were designed to vary either the level of food processing in the image (a whole orange versus a glass of juice) or the text shown (processed versus unprocessed). The results show that displaying an image of a glass of juice during tasting leads to purer taste evaluations, while showing an image of a whole orange encourages certain consumers to score it higher for purity of taste and be more willing to buy it.

Nevertheless, despite the progress made in this field thus far, certain aspects of how the image of the product displayed on a package affects consumer perception during tasting are yet poorly understood. From the designer's and producer's perspective, it is quite reasonable to question whether or not the specific image chosen to be depicted on the label will affect consumer perception during tasting, even when all the options being considered are congruent, pleasant, and have a similar symbolic meaning. In this context, the choice of one particular image may influence the expectations of the consumer,[32] but it is not clear if it may also influence consumer perception of sensory and non-sensory attributes, product liking, or the willingness to buy the product again.

In addition, there is reason to believe that the image seen on the package during tasting does not affect all consumers equally. The response of consumers to a product's extrinsic cues may be influenced by individual characteristics like the capacity to understand and interpret visual cues or to understand context-related constructs.[2] In fact, according to previous research, the gender of the consumer

may play an important role in modulating the effect of a product's extrinsic cues on a consumer's perception.[35] Women may be more sensitive to odour and flavour than men[36,37] and may be more sensitive to subtle changes in a product's visual appearance because they are more sensitive to colour than men.[38,39] This is reflected in facts such as lighting having a greater effect on the sensory perception of women than on the sensory perception of men[40] or obese women perceiving some sensory properties more intensely than obese men.[41] For all of these reasons, it seems reasonable to expect the perception of women to be more sensitive to the effect of the image shown on a package than the perception of men.

Given the above, this study aims to help packaging designers and producers by deepening the current understanding of how the decisions made during the design phase affect the consumer's perception and evaluation of the product. Hence, the key research questions of this study are stated below:

- Does the image of the product depicted on a food package affect how consumer perceives sensory and non-sensory attributes?
- Does the image of the product depicted on a food package influence consumer hedonic response?
- Does the image of the product depicted on a food package influence consumer willingness to rebuy the product?
- Are there gender differences, so that those effects are stronger for women than for men?

In order to answer these questions, apple sauce was chosen because this is a product that can have a number of pleasant and congruent images of apples, varying only in their visual appearance, displayed on its label.

2 | MATERIALS AND METHODS

2.1 | Participants

Some 147 people, composed on 75 men and 72 women, participated in this experiment, conducted during the months of March and April 2016. Participants ranged between 15 and 71 years old, with a median age of 28.9 years and with a standard deviation of 14.48. All of the participants were screened for colour-blindness using the Ishihara test and passed.[42]

2.2 | Stimuli

A single variable was used to design the stimuli of this experiment: the visual appearance of an apple pictured on the packaging label. A generic representation of two apples, a green apple and a red apple, was created from a photograph of an apple by digitally modifying the hue of its skin. The intention was to display two different pleasant and congruent ways of depicting an apple, both easily recognizable by consumers. The stimuli were designed to be as realistic as possible.

Two visual stimuli were designed. The labels were designed following a composition common to many of the brands on the market. The graphic elements on the front of the label were the product description—apple sauce—, the marketing messages—"no added sugar" and "only the best natural fruit"— and the image variable—either a red or green apple. The green apple image pictured two green apples, one cut in half, beneath the text. To ensure the only difference between the stimuli was indeed the visual appearance of the apples, the exact same image was used in each with the original green apple image being digitally retouched to change the apple skin's hue to red. The back of the label contained the nutritional information, weight, barcode, postal address of the manufacturer, and all the information normally displayed on a label of this type. With the exception of the image variable which varied between stimuli—the hue of the skin of the apple displayed—other elements and information used in both stimuli were identical both in form and size to prevent interference from other variables. Both stimuli can be seen in Figure 1.

Each jar was closed using a seal displaying the brand used for this experiment, Delcampo. This brand was created especially for this experiment to prevent participants from inferring products with certain attributes owing to possible associations with real brands.

For the jars, a cylindrical jar was chosen bearing no special marks or elements to ensure test participants did not associate them with real brands. Several sample jars for each variable were created. The

FIGURE 1 Stimuli used in the experiment

jars were then filled with a brand of apple sauce that is rarely found on the Spanish market and were then finally labelled for testing.

The labels were designed using software Illustrator CC and Photoshop CC. The photo of the green apples was purchased with a standard license from the iStockphoto online stock photo library.

2.3 | Procedure

The product tasting was conducted in a room with stable lighting conditions and temperature. All participants took the test voluntarily and anonymously. To ensure evaluations were unbiased by others' opinions, each participant performed the test alone. Participants were not aware of the true aim of the experiment.

A between-subjects experimental design procedure was used. The experimental procedure followed an alternate order, that is, the jar was changed to ensure the variable was not the same as the previous participant's. Thus, 74 participants tested the Red apple variable and 73 tested the Green apple variable. The Red apple cohort was composed of 36 men (48.6%) and 38 women (51.4%) with a mean age of 29.1 years and a standard deviation of 14.18. The Green apple cohort was composed of 39 men (53.4%) and 34 women (46.6%) with a mean age of 28.8 years and a standard deviation of 14.87. Checks were carried out to ensure there were no differences in age and gender variables between the two groups.

The tasting procedure went as follows. Once the participant had entered the room, it was explained to them that they would be evaluating a new line of apple sauce that the Delcampo Company had just launched on the market. They were asked to test a small sample of the product and answer a short survey. They were then seated at the table, where there was a sealed apple sauce jar with which they could interact freely and were handed a cup with a sample of sauce and a teaspoon. They were told they could pick up and look at the jar for as long as they wanted and were asked to try the sample in order to fill out the survey. The sample was prepared whilst the participants were in the room using a labelled jar identical to the one on the table. The apple sauce that participants tasted was the same commercial apple sauce with which the jars were filled. Each sample contained 15 g of apple sauce. The serving temperature was 5°C. To ensure this temperature was maintained, the apple sauce was kept in a refrigerator for at least 24 hours. Once the participants had tasted the apple sauce and answered the survey, they were thanked and debriefed.

2.4 | Measurements

The survey was structured in two sections: one containing control questions (age and gender) and the other asking participants to evaluate a series of attributes of the sample of apple sauce they had just tasted. The list of attributes evaluated is shown in Table 1.

Sweet and *Acidic* attributes were measured in order to analyse if the sensory properties of the depiction of each apple influenced consumer perception. The rest of the sensory and non-sensory attributes, as well as *Liking* and *Willingness to buy*, were measured with an exploratory aim as they were identified as relevant attributes for this product by a panel of experts made up of design professionals and marketers.

TABLE 1 List of product attributes used in the research

Product Attributes			
Sensory	**Non-sensory**	**Liking**	**Willingness**
Sweet	Healthy	Liking	To buy
Acidic	Natural		
Intense flavour	Quality		

Participants were asked to evaluate each of the sensory and non-sensory attributes of the product following a Likert-7 scale, where 1 represented "strongly disagree" and 7 was "completely agree". Participants were asked not to leave any questions blank.

To allow participants to indicate how much they had liked the product, a Likert-7 scale was used, where 1 represented "did not like it at all" and 7, "liked it a lot". To end the survey, participants were asked whether or not they would be willing to buy the product on a Likert-7 scale, where 1 indicated "would not buy under any circumstances" and 7, "would be totally willing to buy it".

2.5 | Data analysis

The mean and standard deviation for the descriptive study of the variables were calculated. In order to analyse the differences between gender and stimuli for the group of all the attributes, the MANOVA-Biplot (multivariate analysis of variance) technique for two independent factors was used.[43] The main limitation of this technique is the complexity of the presentation of the results and their interpretation, particularly when there are many variables owing to the interrelationships among them. This has led many researchers to perform univariate analyses of each variable separately resulting in errors or omissions when interpreting the results. Biplot methods have been used to help the interpretation of the MANOVA results. Thus, the MANOVA-Biplot technique[44] and the canonical biplot technique[45,46] were created, allowing a weighted representation of the matrix of means, calculating the matrix positions with a maximum potential to discriminate among groups. This technique enables a graphical representation to be created to identify the main differences among groups, the variables responsible for the differences and inferences to be determined about the canonical and original variables through confidence circles placed over the points that represent the groups. In the MANOVA-Biplot for two independent factors, an image can be created to represent each of the factors as well as their interaction. If the interaction is significant, as is the case for univariate ANOVAS, analysing the two factors separately is irrelevant because it is necessary to analyse the causes of the differences taking into account the interaction. This is done by using the total biplot technique to find out the positions that most separate the means of the set total of groups defined by the combination of the levels of both factors. In the representation of the total biplot, univariate trust circles are displayed with the Bonferroni correction. If the trust circles are projected over the attributes or the canonical axes, an estimation of intervals of trust for each attribute or canonical axis can be obtained. If the projections of the trust circles do not overlap, this

means that statistically significant differences have been identified. A statistically significant difference was defined as $P < 0.05$.

SPSS for Windows™ (IBM SPSS Statistics 23.0) was used to the descriptive analyses, and the MULTbiplot[47] was used to carry out the MANOVA-Biplot.

3 | RESULTS

The descriptive statistics of each of these groups is shown below. The data is separated by visual appearance of apple in Table 2, by gender in Table 3, and by interaction between both in Table 4.

The data show that the Red apple variable scored higher than the Green apple variable in all the attributes apart from *Acidic* and *Intense Flavour*, where the opposite is true, and that the men surveyed gave all attributes higher average scores than the women. Moreover, the data show that the men gave higher average scores to the Red apple variable only for the attribute *Sweet* and higher scores for the Green apple variable in all other attributes. The women gave higher average scores to the Red apple variable for the attributes *Sweet*, *Healthy*, *Natural*, *Quality*, *Liking*, and *Willingness to buy*, and only scored the Green apple higher for the attributes *Acidic* and *Intense flavour*.

A MANOVA-Biplot of both factors was conducted. The results are displayed in Table 5, showing that the interaction between the two factors is close to being significant.

Given that the interaction is close to be significant and the importance of its presence in the interpretation of the main factors, a total biplot was conducted. This biplot helps us to understand the behaviour of the factors in the presence of the interactions. The variability explained by the first two is 0.89. In levels 1 to 2, it can be seen that the differences are mainly owing to the behaviour of women when evaluating the stimuli in different attributes. Factor 1 presents high correlations mainly with *Willingness to buy* and, to a lesser extent, with *Liking* and *Quality*. This axis displays the significant differences between women and the Green apple variable with the other groups, presenting the most extreme positions of women in relation to the choice of stimuli. These differences are shown in the attributes *Willingness to buy*, *Healthy*, and *Liking*. Factor 2 discriminates the groups (absorbing 21.6% of variability). This factor has higher correlations with the attributes *Acidic*, *Intense flavour*, and, to a lesser extent, *Sweet*. The results for men were very similar and insignificant in all the attributes for both stimuli. The canonical representation of the cohort is shown in Figure 2.

4 | DISCUSSION

The aims of this study were to analyse whether or not the image displayed on the packaging of a food product has an effect on consumer perception during tasting, *Liking*, and *Willingness to buy* as well as to observe if any gender differences exist in the intensity of this effect. To this end, apple sauce was chosen to be the product in this study.

Despite the lack of significant impact on some of the attributes studied, the results show that the visual appearance of the apple depicted on the packaging image (the Red apple or the Green apple)

TABLE 2 Descriptive statistics of the separation by visual appearance of apple

	Green Apple			Red Apple		
Product attributes	***N***	**Mean**	**Standard deviation**	***N***	**Mean**	**Standard deviation**
Sweet	73	5.33	1.28	74	5.66	1.16
Acidic	73	3.03	1.54	74	2.65	1.62
Intense flavour	73	5.16	1.09	74	5.07	1.13
Healthy	73	4.73	1.55	74	5.22	1.06
Natural	73	5.31	1.31	74	5.45	1.12
Quality	73	5.29	1.05	74	5.65	1.01
Liking	73	5.11	1.54	74	5.70	1.18
Willingness to buy	73	4.47	1.63	74	4.96	1.37

TABLE 3 Descriptive statistics of the separation by gender

	Men			Women		
Product Attributes	***N***	**Mean**	**Standard Deviation**	***N***	**Mean**	**Standard Deviation**
Sweet	75	5.64	1.16	72	5.35	1.29
Acidic	75	3.07	1.63	72	2.60	1.52
Intense flavour	75	5.20	0.99	72	5.03	1.22
Healthy	75	5.09	1.23	72	4.85	1.45
Natural	75	5.51	1.17	72	5.25	1.26
Quality	75	5.49	0.93	72	5.44	1.15
Liking	75	5.61	1.11	72	5.19	1.62
Willingness to buy	75	4.88	1.22	72	4.54	1.78

TABLE 4 Descriptive statistics of the interaction between visual appearance of apple and gender

	Men						Women					
	Green apple			Red apple			Green apple			Red apple		
Product attributes	*N*	Mean	sd	*N*	Mean	sd	*N*	Mean	sd	*N*	Mean	sd
Sweet	39	5.44	1.12	36	5.86	1.17	34	5.20	1.45	38	5.47	1.13
Acidic	39	3.13	1.56	36	3.00	1.72	34	2.91	1.52	38	2.31	1.47
Intense flavour	39	5.23	1.01	36	5.17	0.97	34	5.09	1.19	38	4.97	1.26
Healthy	39	5.10	1.43	36	5.08	1.00	34	4.29	1.59	38	5.34	1.12
Natural	39	5.59	1.25	36	5.41	1.08	34	5.00	1.33	38	5.47	1.18
Quality	39	5.51	0.79	36	5.47	1.08	34	5.03	1.24	38	5.82	0.93
Liking	39	5.62	1.09	36	5.61	1.15	34	4.53	1.78	38	5.79	1.21
Willingness to buy	39	5.05	1.25	36	4.69	1.17	34	3.79	1.77	38	5.21	1.51

TABLE 5 MANOVA results

Source	Lambda	*F* Value	gl 1	gl 2	*P*-Value
Gender	0.919	1.50	8	136	0.162
Stimulus	0.872	2.49	8	136	0.015
Interaction	0.896	1.98	8	136	0.053

affected some of the attributes evaluated, with this trend being particularly pronounced for women. Gender differences were identified as the influence of the apple pictured on the packaging was not the same for both genders.

With respect to the sensory attributes, the men perceived the apple sauce from the Red apple jar to be slightly sweeter than that from the Green apple jar and the women perceived the apple sauce from the Green apple jar to be slightly more acidic than that from the Red Apple jar. These results are coherent with the sensory properties of the apples varieties consumed in Spain, where green apple varieties tend to be more acidic and red apple varieties tend to be sweeter.[48] As these differences were not statistically significant, it cannot be stated that the consumer attributes the same sensory characteristics to the product as they do to the product image shown on the package. As was the case with the study conducted by Mizutani et al,[34] flavour intensity was not affected by either stimulus. The absence of statistical significance may be explained by the experimental design chosen for this study, in which participants only tasted the apple sauce provided from one of the packages without being aware of the existence of the other.

Regarding the attributes studied with an exploratory aim, the differences found in the non-sensory attributes (ie, *Healthy* and *Quality*), *Liking* and *Willingness to buy* stem from the evaluations conducted by women, who scored the apple sauce served from a jar with a label depicting a red apple higher than the apple sauce served from a jar with a label depicting a green apple. The differences found in the evaluations of these attributes by the male participants are not statistically significant, showing that men are less sensitive than women to the visual appearance of the apple depicted on the label.

There are two factors that may explain the gender differences identified in the results. The first is that women and men display different food preferences and practices.[35] Women are significantly more involved in food than men and pay more attention to the information displayed on food packaging than men.[49] Thus, it is possible that the women paid greater attention to the packaging than the men, and therefore the image shown had a greater effect on them. The second factor to take into account is that women are more sensitive to colour than men.[38,39] This higher level of colour sensitiveness may explain why the effect of the tone of the skin of the apple shown on the label was higher in women than in men.

With respect to the relationships identified among the different attributes, it can be seen how, as found in the results from the study conducted by Rebollar et al,[29] there is a strong positive relationship between the attribute *Healthy* and *Willingness to buy*. As such, to depict an image perceived as healthy on a package may increase consumers' willingness to buy. This is also in line with other works that suggest that both health and quality are two important factors in product acceptance.[50-52]

From a methodological perspective, the experiment conducted in this study was designed in an attempt to create an experience that was as realistic as possible for participants, who were told that they were to evaluate a new product that was about to be marketed. In contrast to previous research, where participants were not able to see and touch a real package,[2,33,34] in this experiment each participant was given the sealed commercial product and a sample of it to taste. At no point were they asked to evaluate the product packaging, nor was this insinuated in any way. As such they interacted with it in an unprompted manner. None of the participants were aware of the real aim of the experiment. Moreover, the only difference between the stimuli was the colour of the apple pictured on the packaging, meaning the difference between the stimuli was very subtle. However, we consider that the conservative approach taken to conduct this study, which could be seen as a limitation, enhances the validity of its results. The fact that significant differences were found, given such conditions, is indicative of the role that the image depicted on the package has in shaping the evaluations of consumers.

4.1 | Limitations and directions for further research

The study presented has some limitations that have to be taken into account. Despite the attempt to conduct this experiment in a realistic

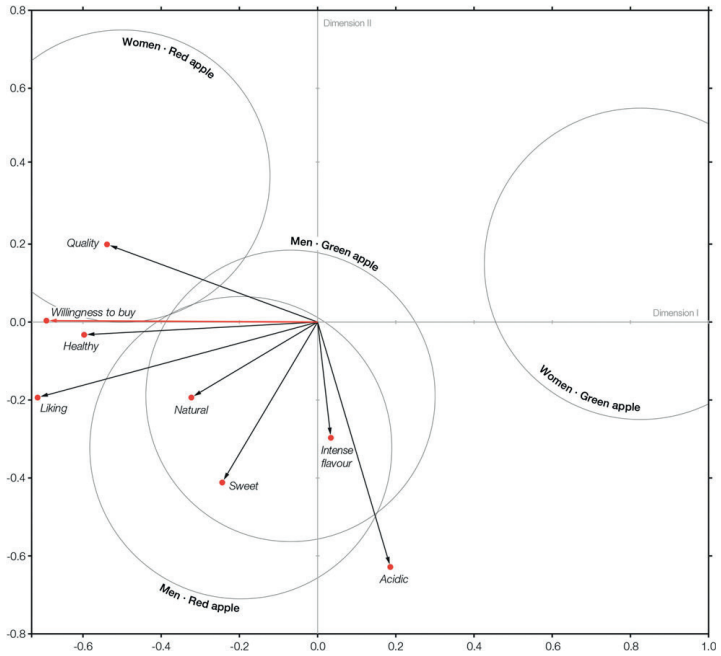

FIGURE 2 Canonical representation of the cohort

setting, the study was conducted in a consumption environment that did not reflect real life conditions, in which consumers taste products in a domestic environment. The similarity of some characteristics of the jars used in this experiment with some commercial brands, such as the format or the colour, could have affected the evaluation of certain attributes because the stimuli could have inferred experiences and sensations associated with product consumers had consumer prior to the experiment. In order to try to avoid this kind of interference, a neutral design was used in which the other variables on the packaging design—such as the company name, brand, and typography—differed greatly from commercial brands on the market. As in any other study conducted following a between-subjects design, the fact that each package was evaluated by different participants may raise concerns regarding the nature of the found effects; however, both groups of participants were analysed, and no statistical differences between them were found.

With respect to future research, it would be interesting to conduct a new study in order to better understand the reasons why differences were found in some of the non-sensory attributes as well as in *Liking* and *Willingness to buy*. Specifically, we think that a new study should address the mechanism behind the effects found in this experiment in order to better understand the underlying processes that explain the influence of the image depicted on the packaging on consumer expectations. Moreover, we think that a possible next step would be to assess the role of individual differences regarding health consciousness. It would also be interesting to assess if these effects can be replicated with other products, such as an apple juice, or regarding other factors of the visual appearance of the product, such as its shape.

5 | CONCLUSION

The visual aspect of a product depicted in the image on a food package affects the way in which consumers evaluate certain product characteristics during tasting. These effects, however, are not the same for all consumers. The results of this study show that gender differences exist between men and women, with women being more sensitive than men. Likewise, the visual appearance of the product pictured did not influence all attributes equally: differences were identified in the evaluation of attributes such as how healthy the product was perceived to be, as well as its quality, which, in turn, positively affect liking and willingness to buy. Nevertheless, the image pictured has a modest effect on the assessment of the sensory attributes of the product; although a congruent trend is visible, the data are not statistically significant. The results of this study underscore the importance of the design decisions made by designers and producers during the packaging design process, and its effects on consumer evaluation and acceptation of the product. Future work should include studying the nature of the mechanism behind these effects, the role of other individual differences such as health consciousness, and the replication of the findings of this experiment in other products.

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REFERENCES

1. Clement J. Visual influence on in-store buying decisions: an eye-track experiment on the visual influence of packaging design. *J Mark Manag*. 2007;23(9–10):917-928. https://doi.org/10.1362/026725707X250395
2. Machiels CJA, Karnal N. See how tasty it is? Effects of symbolic cues on product evaluation and taste. *Food Qual Prefer*. 2016;52:195-202. https://doi.org/10.1016/j.foodqual.2016.04.014
3. Piqueras-Fiszman B, Spence C. Sensory expectations based on product-extrinsic food cues: an interdisciplinary review of the empirical evidence and theoretical accounts. *Food Qual Prefer* 2015;40 (PA):165–179. https://doi.org/10.1016/j.foodqual.2014.09.013.
4. Deliza R, Macfie H, Hedderley D. Use of computer-generated images and conjoint analysis to investigate sensory expectations. *J Sens Stud*. 2003;18(6):465-486. https://doi.org/10.1111/j.1745-459X.2003.tb00401.x
5. Hutchings JB. *Expectations and the Food Industry: The Impact of Color and Appearance*. New York: Kluwer Academic/Plenum Publishers; 2003.
6. Swientek B. Uncanny developments. *Beverage Ind*. 2001;92(12):38-39.
7. Kauppinen-Räisänen H. Strategic use of colour in brand packaging. *Packag Technol Sci*. 2014;27(8):663-676. https://doi.org/10.1002/pts. 2061
8. Piqueras-Fiszman B, Spence C. Crossmodal correspondences in product packaging. Assessing color-flavor correspondences for potato chips (crisps). *Appetite*. 2011;57(3):753-757. https://doi.org/10.1016/j.appet. 2011.07.012
9. Rebollar R, Lidón I, Serrano A, Martín J, Fernández MJ. Influence of chewing gum packaging design on consumer expectation and willingness to buy. An analysis of functional, sensory and experience attributes. *Food Qual Prefer*. 2012;24(1):162-170. https://doi.org/10.1016/j.foodqual. 2011.10.011
10. Smets GJF, Overbeeke CJ. Expressing tastes in packages. *Des Stud*. 1995;16(3):349-365. https://doi.org/10.1016/0142-694X (94)00003-V
11. Bone PF, France KR. Package graphics and consumer product beliefs. *J Bus Psychol*. 2001;15(3):467-489. https://doi.org/10.1023/A:1007826818206
12. Magnier L, Schoormans J. How do packaging material, colour and environmental claim influence package, brand and product evaluations? *Packag Technol Sci*. May 2017;30(11):735-751. https://doi.org/10.1002/pts. 2318
13. Celhay F, Boysselle J, Cohen J. Food packages and communication through typeface design: the exoticism of exotypes. *Food Qual Prefer*. 2015;39:167-175. https://doi.org/10.1016/j.foodqual.%202014.07.009
14. Orth UR, Campana D, Malkewitz K. Formation of consumer price expectation based on package design: attractive and quality routes. *J Mark Theory Pract*. 2010;18(1):23-40. https://doi.org/10.2753/MTP1069-6679180102
15. Karnal N, Machiels CJA, Orth UR, Mai R. Healthy by design, but only when in focus: communicating non-verbal health cues through symbolic meaning in packaging. *Food Qual Prefer*. 2016;52:106-119. https://doi.org/10.1016/j.foodqual. 2016.04.004
16. Becker L, van Rompay TJL, Schifferstein HNJ, Galetzka M. Tough package, strong taste: the influence of packaging design on taste impressions and product evaluations. *Food Qual Prefer*. 2011; 22(1):17-23. https://doi.org/10.1016/j.foodqual. 2010.06.007
17. Simmonds G, Spence C. Thinking inside the box: how seeing products on, or through, the packaging influences consumer perceptions and purchase behaviour. *Food Qual Prefer*. 2016;1-12. https://doi.org/10.1016/j.foodqual. 2016.11.010
18. Ampuero O, Vila N. Consumer perceptions of product packaging. *J Consum Mark*. 2006;23(2):100-112. https://doi.org/10.1108/07363760610655032
19. Rebollar R, Lidón I, Martín J, Puebla M. The identification of viewing patterns of chocolate snack packages using eye-tracking techniques. *Food Qual Prefer*. 2015;39:251-258. https://doi.org/10.1016/j.foodqual. 2014.08.002
20. Liao LX, Corsi AM, Chrysochou P, Lockshin L. Emotional responses towards food packaging: a joint application of self-report and physiological measures of emotion. *Food Qual Prefer*. 2015;42:48-55. https://doi.org/10.1016/j.foodqual. 2015.01.009
21. Underwood RL, Klein NM. Packaging as brand communication: effects of product pictures on consumer responses to the package and brand. *J Mark Theory Pract*. 2002;10(4):58-68. http://linksource.ebsco.com.roble.unizar.es%3A9090%2FFullText.aspx%3Flinkout%3Dhttp%3A%2F%2Froble.unizar.es%3A9090%2Flogin%3Furl%3Dhttp%3A%2F%2Fgateway.proquest.com%2Fopenurl%3Furl_ver%3DZ39.88%25E2%2580%2593-2004%26amp%3Bres_dat%3Dxri%3Apqm%26amp%3Brft_val_fmt%3Dinfo%3Aofi%2Ffmt%3Akev%3Am
22. Underwood RL, Klein NM, Burke RR. Packaging communication: attentional effects of product imagery. *J Prod Brand Manag*. 2001;10(7):403-422. https://doi.org/10.1108/10610420110410531
23. Jaeger SR, MacFie HJH. The effect of advertising format and means-end information on consumer expectations for apples. *Food Qual Prefer*. 2001;12(3):189-205. https://doi.org/10.1016/S0950-3293 (00)00044-6
24. Zeithaml VA. Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence. *J Mark*. 1988;52(3):2-22.
25. J-BEM S. Conceptual model of the quality perception process. *J Bus Res*. 1990;21(4):309-333. https://doi.org/10.1016/0148-2963 (90)90019-A
26. Cardello AV. Measuring consumer expectations to improve food product development. In: MacFie HJH, ed. *Consumer-Led Food Product Development*. Cambridge: Elsevier; 2007:223–261. https://doi.org/10.1533/9781845693381.2.223
27. Spence C, Piqueras-Fiszman B. The multisensory packaging of beverages. In: Kontominas MG, ed. *Food Packaging: Procedures, Management and Trends*. Hauppauge: Nova Publishers; 2012:187-234 http://www.scopus.com/inward/record.url?%20eid=2-s2.0%E2%8093-84883720504&partnerID=tZOtx3y1.
28. Kobayashi ML, Benassi M de T. Impact of packaging characteristics on consumer purchase intention: instant coffee in refill packs and glass jars. *J Sens Stud*. 2015;1-12. https://doi.org/10.1111/joss. 12142
29. Rebollar R, Lidón I, Gil I, Martín J, Fernández MJ, Riveres CE. The influence the serving suggestion displayed on soft cheese packaging has on consumer expectations and willingness to buy. *Food Qual Prefer*. 2016;52:188-194. https://doi.org/10.1016/j.foodqual. 2016.04.015
30. Madzharov AV, Block LG. Effects of product unit image on consumption of snack foods. *J Consum Psychol*. 2010;20(4):398-409. https://doi.org/10.1016/j.jcps. 2010.06.007
31. Neyens E, Aerts G, Smits T. The impact of image-size manipulation and sugar content on children's cereal consumption. *Appetite*. 2015;95:152-157. https://doi.org/10.1016/j.appet. 2015.07.003
32. Rebollar R, Gil I, Lidón I, Martín J, Fernández MJ, Rivera S. How material, visual and verbal cues on packaging influence consumer expectations and willingness to buy: the case of crisps (potato chips) in Spain. *Food Res Int*. 2017;99(Pt 1):239-246. https://doi.org/10.1016/j.foodres. 2017.05.024
33. Sakai N, Morikawa S. The pictures of fruits juices affect flavor perception of fruit juices. *Japanese Assoc Study Tast Smell*. 2006; 13(3):463-466.
34. Mizutani N, Okamoto M, Yamaguchi Y, Kusakabe Y, Dan I, Yamanaka T. Package images modulate flavor perception for orange juice. *Food Qual Prefer*. 2010;21(7):867-872. https://doi.org/10.1016/j.foodqual. 2010.05.010
35. Beardsworth A, Bryman A, Keil T, Goode J, Haslam C, Lancashire E. Women, men and food: the significance of gender for nutritional

attitudes and choices. *Br Food J*. 2002;104(7):470-491. https://doi.org/10.1108/00070700210418767

36. Bartoshuk LM, Duffy VB, Miller IJ. PTC/PROP tasting: anatomy, psychophysics, and sex effects. *Physiol Behav*. 1994;56(6):1165-1171. http://www.ncbi.nlm.nih.gov/pubmed/7878086 Accessed November 16, 2016
37. Oliveira-Pinto AV, Santos RM, Coutinho RA, et al. Sexual dimorphism in the human olfactory bulb: females have more neurons and glial cells than males. *Ravel N, Ed PLoS One*. 2014;9(11):e111733. https://doi.org/10.1371/journal.%20pone.%200111733
38. Bimler DL, Kirkland J, K a J. Quantifying variations in personal color spaces: are there sex differences in color vision? *Color Res Appl*. 2004;29(2):128-134. https://doi.org/10.1002/col. 10232
39. Rodríguez-Carmona M, Sharpe LT, J a H, Barbur JL. Sex-related differences in chromatic sensitivity. *Vis Neurosci*. 2008;25(03):433-440. https://doi.org/10.1017/S095252380808019X
40. Rebollar R, Lidón I, Guzmán R, Gil I, Martín J. The influence of illuminance level on perception and willingness to buy during the tasting of sweetened natural yoghurt. *Food Qual Prefer*. 2017;62:270-274. https://doi.org/10.1016/j.foodqual.%202017.05.007
41. Proserpio C, Laureati M, Invitti C, Cattaneo C, Pagliarini E. BMI and gender related differences in cross-modal interaction and liking of sensory stimuli. *Food Qual Prefer*. 2016. https://doi.org/10.1016/j.foodqual.%202016.09.011
42. Ishihara S. *Ishihara's Tests for Colour Deficiency (38 Plates Edition)*. Kanehara Trading: Tokyo; 2003.
43. Amaro IR, Vicente-Villardón JL, Galindo-Villardón MP. Manova Biplot para arreglos de tratamientos con dos factores basado en modelos lineales generales multivariantes. *Interciencia*. 2004;29(1):26-32.
44. Gabriel KR. MANOVA Biplots for twoway contingency tables. In: Krzanowski W, ed. *Recent Advances in Descriptive Multivariate Analysis*. Oxford, UK: Clarendon Press; 1995:227-268.
45. Gower JC, Hand DJ. *Biplots*. London: Chapman & Hall; 1995.
46. Vicente-Villardón JL. *Una alternativa a los métodos factoriales clásicos basada en una generalización de los métodos biplot*. 1992.
47. Vicente-Villardón JL. MULTBIPLOT: a package for multivariate analysis using biplots. Departamento de Estadística. Universidad de Salamanca. http://biplot.usal.es/ClassicalBiplot/index.html.Published2015. Accessed July 8, 2016.
48. Illescas JL, Bacho O, Ferrer S. *Guía Práctica de Frutas Y Hortalizas*. Madrid: Mercasa; 2008.
49. Vila-López N, Kuster-Boluda I. Adolescents' food packaging perceptions. Does gender matter when weight control and health motivations are considered? *Food Qual Prefer*. 2016;52:179-187. https://doi.org/10.1016/j.foodqual. 2016.04.012
50. Pravst I, Kušar A, Žmitek K, et al. Recommendations for successful substantiation of new health claims in the European Union. *Trends Food Sci Technol*. August 2017;2018(71):259-263. https://doi.org/10.1016/j.tifs.%202017.10.015
51. Chrysochou P, Krystallis A, Giraud G. Quality assurance labels as drivers of customer loyalty in the case of traditional food products. *Food Qual Prefer*. 2012;25(2):156-162. https://doi.org/10.1016/j.foodqual.2012.02.013
52. Walters A, Long M. The effect of food label cues on perceptions of quality and purchase intentions among high-involvement consumers with varying levels of nutrition knowledge. *J Nutr Educ Behav*. 2012;44(4):350-354. https://doi.org/10.1016/j.jneb.2011.08.008

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3.5. Study 5

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What do you mean by hot? Assessing the associations raised by the visual depiction of an image of fire on food packaging

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ABSTRACT

The images shown on food packaging play an important role in the processes of identification, categorisation and the generation of expectations, since the consumer uses the images to infer information about the product. However, a given image may convey different meanings (e.g. in a food package, "fire" may mean *barbecued* or *spicy*), so it is very important for producers and designers to understand the factors responsible for consumers inferring a specific meaning. This paper addresses this problem and shows experimentally that the consumer tends to infer the meaning from the image which is most congruent with the product it is displayed with. 65 participants carried out two speeded classification tasks which results show an interaction between the product (congruent vs. incongruent) and the image (with fire vs. without fire): products congruent with a meaning of fire were categorised more quickly when shown with fire than without it, while products incongruent with a meaning of fire were categorised more slowly when shown with fire than without it. In addition, the results show that stimuli were categorised more quickly when the interpretation of fire was literal (e.g. barbecue) than in those that were metaphorical (e.g. spiciness), indicating that the rhetorical style of the image (literal or metaphorical) influences the cognitive effort required to process it. These contributions improve our understanding of the effect of the images shown on packaging in the communication between packaging and consumers.

1. Introduction

When consumers first observe a product, they use its visual appearance to identify and categorise it (Loken, 2006; Loken, Barsalou, & Joiner, 2008). Categorisation is the process by which consumers organise and group information into categories, i.e. sets of entities, objects or events related to each other in some way. In the context of shopping in a supermarket, this process allows the consumer to group and classify the different products according to their attributes and common features (Loken et al., 2008). Indeed, packaging is considered a relevant communication tool used by brands to inform consumers (Azzi, Battini, Persona, & Sgarbossa, 2012; Mumani & Stone, 2018), and its different elements and features act as signs from which consumers infer meaning –enabling them to identify and categorise each product (Celhay & Remaud, 2018; Festila & Chrysochou, 2018; Spence, 2018). As indicated by Ares et al. (2011), based on the semiotics of Peirce (1991), two main types of signs can be distinguished in the context of food packaging: linguistic signs, which produce meaning only by social convention (e.g. texts and verbal expressions), and visual signs, which produce meaning by resemblance (e.g. colours, shapes, images and illustrations). Both types of signs are frequently used in food packaging and the consumer relies on both textual claims as well as images and other visual features to identify and categorise the product; thus enabling the generation of expectations (Smith, Barratt, & Selsøe Sørensen, 2015). While the role played by linguistic signs and some visual signs such as colour in these processes have been widely studied to date (Kauppinen-Räisänen, 2014; Lähteenmäki, 2013; Magnier & Schoormans, 2017; Piqueras-Fiszman & Spence, 2015; Spence & Piqueras-Fiszman, 2014; Sütterlin & Siegrist, 2015); the specific effect of the images displayed on the packaging in the communication between package and consumer has received less attention.

Compared to textual claims, the role of images in the categorisation process is especially prominent because they are the first elements from which the consumer infers meaning: images capture the attention faster than texts (Honea & Horsky, 2012; Silayoi & Speece, 2007; Venter, van der Merwe, de Beer, Kempen, & Bosman, 2011) and their processing require less cognitive effort (Mueller, Lockshin, & Louviere, 2009; Underwood & Klein, 2002). Images access the semantic representation

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of a concept with more speed than words (Pellegrino, Rosinski, Chiesi, & Siegel, 1977; Potter & Faulconer, 1975; Smith & Magee, 1980), so the consumer generates expectations more quickly by seeing an image than by reading a text (Underwood & Klein, 2002). Controlling the first impact produced by a package through the way in which the image is interpreted is crucial, since the first impression tends to influence the judgment of the consumer and may condition the subsequent attitude towards the product (Epley & Gilovich, 2006; Madzharov & Block, 2010).

However, it should be noted that not all images are processed in the same way. The rhetorical style of an image conditions the way in which its meaning is processed. The rhetorical style of an image refers to whether its meaning is literal or metaphorical (Jeong, 2008; Phillips & McQuarrie, 2002). From a cognitive point of view, the process by which a metaphorical message is decoded is more complex than that to interpret a literal message, since it evokes a set of more complex semantic associations in the memory of the observer (Gentner, 1983; Jeong, 2008). The rhetorical style of an image is assumed to be literal when its possible meanings are directly related to the object represented (e.g. showing an image of a strawberry on a food package reminds the consumer that the strawberries have some relation with the flavour, aroma or shape of the product; Smith et al., 2015), while it is assumed that the rhetorical style is metaphorical when the possible meanings of the image are related to another domain than that of the represented object (e.g. showing an image of a lion (source domain) as a metaphor of force in a coffee package (target domain); Fenko, Vries, & Rompay, 2018). It may even be the case that the same image has an ambiguous rhetorical style and can adopt both literal and metaphorical meanings within the same context: e.g. showing an image that represents fire on a food package can have a literal meaning (barbecue) or a metaphorical one (spiciness).

In practice, it is not easy for a designer to anticipate the meaning a consumer will infer from an image displayed on a food package. An image by itself is propositionally indeterminate and can evoke many interpretations in the mind of the consumer, since it lacks the syntactic devices necessary to emit an explicit propositional meaning (Messaris, 1994, 1997; Smith et al., 2015). For example, consider the case of depicting a strawberry on a food package: the consumer may interpret the product as tasting of strawberries, made of strawberries and so on (Smith et al., 2015). Although this propositional indeterminacy can be broken by making the meaning of the image explicit by using supporting text (Barthes, 1977; Phillips, 2000), the paths by which the meanings of both components are decoded (text and image) are different and can lead to different interpretations. In that case, an additional process is required through which a definitive meaning is selected and the conflict thus resolved (Lewis & Walker, 1989), which can negatively affect the processing fluency and the overall attitude toward the product (Alter & Oppenheimer, 2009). However, for a packaging designer, knowing the factors responsible for the same image evoking one meaning or another in different contexts is essential to achieving effective communication with the consumer through packaging. This research aims to shed light in this regard by proposing that the congruence between the possible meanings of an image displayed on a food package and the product in which it is applied is key in the process by which consumers infer meaning from that image.

The context in which an image is depicted (e.g. the signs and cues that surround it) helps the observer's brain to consider its possible meanings (Miller, Malhotra, & King, 2006). Thus, it is assumed that the same image will elicit a different set of associations according to its context since, according to Sperber and Wilson's principle of relevance (Sperber & Wilson, 1995), the consumer will assume that the presence of the image is relevant in that context and discard the meanings that do not fit it. For example, it is reasonable to think that the same image of fire will convey meanings related to danger if displayed on a chemical container (e.g. hazardous or flammable), or meanings related to food if displayed on a food package (although it is worth noting that there may be some exceptions, as in the case of icons referring the food package itself). Therefore, in the context of food packaging, a fire image could elicit literal meanings (directly related to fire, e.g. barbecue) or metaphorical meanings (related to the sensory domain, e.g. spiciness; Caterina, Schumacher, Timinaga, & Rosen, 1997; Tu, Yang, & Ma, 2016).[1] As a result, we propose:

H1a. The meanings elicited by an image of fire depicted on food packaging will be directly related to food.

H1b. The meanings elicited by an image of fire depicted on food packaging will have a literal and/or a metaphorical meaning.

Once the possible meanings have been limited after this categorisation process, different interpretations for the same image may still exist. Following the previous example, when depicted on a food package fire can still convey meanings like barbecue and/or spiciness. In the fields of semantics and language, some lines of analysis have been developed that seek to understand the factors by which an indeterminate stimulus evokes a particular meaning. Discussing the existing literature on this subject, Smith et al. (2015) distinguish between two approaches: the slot/filler approach and the analogy approach. The slot/filler approach assumes that if one of the possible meanings of the sign (filler) fits well with any of the possible attributes of the object (slot), the probabilities of opting for that meaning will be greater (Fillmore & Baker, 2010; Lynott & Connell, 2010; Smith, Osherson, Rips, & Keane, 1988). On the other hand, the analogy approach states that the interpretation that has proved valid in similar past combinations will be preferred (Estes & Jones, 2006; Gagné & Spalding, 2006; van Jaarsveld, Coolen, & Schreuder, 1994; see also Gregan-Paxton & John, 1997). According to these approaches, consumers look for congruent associations already existing in their memory when assigning a meaning to a propositionally indeterminate image. Consequently, continuing with the example of fire, the determining factor that would cause the consumer's brain to opt for a specific meaning (literal or metaphorical) would be the congruence of the product with some of these meanings (for an elaboration on congruence/incongruence see Heckler & Childers, 1992). For example, consider a jar of pickles: these can be spicy (i.e. it would be congruent with the metaphorical meaning of fire) but they are not directly related to fire, as they are eaten raw and cold (i.e. it is incongruent with the literal meaning of fire). In that case, we would expect that showing a fire image on a jar of pickles would evoke a metaphorical meaning in the consumer's brain and not literal, as it is the meaning most consistent with that category of product. Thus, we propose:

H2. The meaning assigned by the consumer to an image of fire depicted on food packaging will tend to be that which is more congruent with the product attributes.

According to this reasoning, displaying a fire image next to a product opens up two possibilities. If the product category is congruent with any of the possible meanings of fire (e.g. a steak), the consumer will have a previous congruent association accessible in their memory (barbecue) and processing the pairing will require low cognitive effort. However, if the product category is not consistent with any of the possible meanings of fire (e.g. yoghurt), the consumer will not have any prior congruent association accessible in his memory and processing the

[1] It is worth noting that, strictly speaking, for the fire image meaning to be considered purely 'literal', it should refer to nothing but fire itself. However, in the present paper the term 'literal meaning' will be used to intuitively refer to meanings that are directly related to fire (such as *barbecue* or *roast*). Additionally, although both literal and metaphorical meanings may still contain different possible meanings in their interior (e.g. the literal meaning includes concepts such as *barbecue* or *roast*), for the sake of clarity from now on we will refer to the possible meanings for an image of fire depicted on food packaging as being simply 'literal' or 'metaphorical'.

pairing will require greater cognitive effort. Accordingly, we hypothesise:

H3. The classification of a product category congruent with a meaning of fire will be faster if it is displayed with (vs. without) an image of fire. Similarly, the classification of a product category incongruent with any meaning of fire will be faster if it is displayed without (vs. with) an image of fire.

Finally, as previously stated, we know that metaphorical reasoning requires greater cognitive processing and preparation than literal reasoning, due to the greater number of semantic concepts mobilised (Gentner, 1983; Jeong, 2008; Messaris, 1997). Therefore, we hypothesise:

H4. When displayed with an image of fire the classification of a product category congruent with a literal meaning of fire will be faster than the classification of a product category congruent with a metaphorical meaning of fire.

To summarise, consumers interpret and assign meaning to the images shown on a food package, which influences how they identify and categorise the product and the expectations it generates. Understanding this process is fundamental to ensure that the meaning the consumer assigns to the images depicted on a package is that intended by producers and designers, as well as to promote laws that hinder the use of deceptive messages (Smith et al., 2015; Smith, Møgelvang-Hansen, & Hyldig, 2010). A well-designed package that is easy to interpret and process may improve the global attitude towards the product by reducing processing fluency (Alter & Oppenheimer, 2009) and diminishing the risk of a disconfirmation of expectations (Deliza & MacFie, 1996; Piqueras-Fiszman & Spence, 2015; Schifferstein, 2001). This study goes a step further in this direction by investigating the way in which displaying an image of fire on a food package influences the associations accessed by the consumer and the cognitive effort necessary to process them.

2. Methods

In order to test the proposed hypotheses, two pretests and a main study were conducted. Pretest 1 aimed to assess whether showing a fire image on a food package produces either literal or metaphorical meanings related to food (H1). Pretest 2 aimed to analyse if showing a fire image on a food package makes consumers tend to elicit a meaning that is congruent with both the fire image and the product's possible attributes (i.e. makes a possible product attribute congruent with the fire image more easily accessible on consumers' mind, H2). Finally, the main study aimed to investigate whether the congruence between the image's possible meanings and the product's potential attributes influences the easiness of classifying the product on a speeded classification task (H3), and whether the image's rhetorical style (i.e. literal or metaphorical) affects the cognitive effort required to process it (H4).

Fig. 1. Stimuli used in the second pretest.

2.1. Pretest 1

A group of 35 participants (18 male, mean age 20.8 years) completed an open-ended task. They had to imagine they were shopping in a supermarket and had to complete the sentence: *When I see fire represented on a food package label, I think it means this product is…* The participants were asked to give as many answers as they wanted and respond as quickly as possible. A panel of 3 experts analysed and grouped the answers according to their meaning (e.g. *must be done on a barbecue* or *has been cooked on the grill* would be included under the category *Barbecue*). The meanings elicited were: *Picante* (Spanish for *spicy hot*, N = 34, 97.1%), *Caliente* (Spanish for *temperature hot*, N = 9, 25.7%), *Barbacoa* (Spanish for *barbecue*, N = 5, 14.3%) and *Tostado* (Spanish for *roasted*, N = 2, 5.7%). These results support H1a and H1b, since all meanings are related to food and can be grouped into literal meanings (*Temperature hot*, *Barbecue*, *Roasted*) and metaphorical meanings (*Spicy hot*).[2]

2.2. Pretest 2

Two jars of pickles visuals were designed which differed only in the depiction of an image of fire on the label (with fire vs. without fire, Fig. 1). 50 participants (26 male, mean age 21 years) took part in a free elicitation task responding to the request: *Say the first 5 things that come to your mind when you see this product*. A between-subject design was used, where each participant saw only one of the two jars. Once that task was completed, the participants indicated the degree of congruence of the pickle category with the literal and metaphorical meanings of fire by stating whether or not they agreed with the following phrases: *Pickles can be done on the barbecue, have a barbecue flavour or be roasted* (congruence with the literal meaning) or *Pickles can be spicy* (congruent with the metaphorical meaning). Checks were carried out to ensure there were no differences in terms of age, gender or level of congruence of the product between the two groups. As in the previous pre-test, a panel of 3 experts analysed the responses and excluded all those not related to any possible meaning of fire (e.g. *jar*, *transparent* or *black*). In the group that saw the jar without the image of fire, none elicited any concept related to fire. However, 20 participants of the group that saw the jar with the fire image elicited the 'spicy' concept (N = 20, 80%). No participant elicited a literal concept of fire. This result is explained by this product being considered congruent with the 'spicy' concept and incongruent with the literal meanings of fire, as shown by the participants' answers to the questions related to the congruence of the product with the literal and metaphorical meanings of fire. Thus, it can be seen that a majority of these 20 participants considered the product congruent only with the metaphorical meaning (i.e. it could make sense that some pickles are spicy, N = 11, 55%); some considered it consistent with the metaphorical and literal meanings (i.e. it may make sense that some pickles are spicy and cooked on the barbecue, have a barbecue flavour or be roasted, N = 6, 30%); while some did not consider it congruent with any (i.e. it did not make sense that pickles are spicy or that they have been barbecued, have a barbecue flavour or are roasted, N = 3, 15%). These results show that displaying a fire image on a food package makes concepts accessible in the consumer's memory that would otherwise remain hidden and which align with the most congruent attributes for that product; supporting H2.

[2] From now on, we will refer to *Spicy hot* simply as *Spicy*.

2.3. Main study

2.3.1. Participants

The participants consisted of 65 students (35 female, mean age 20.7 years, sd = 2.5) from the University of Zaragoza, in exchange for being included in a raffle for 6 gift vouchers for a well-known online store. All the participants were unaware of the real objective of the study and participated voluntarily.

2.3.2. Procedure

The main study consisted of two speeded classification tasks and a manipulation check. The speeded classification tasks aimed (1) to study the effect of the congruency between an image and a product category on the easiness of classifying the product, i.e. H3; and (2) to assess the effect of the rhetorical style of the image on the cognitive effort required to process it, i.e. H4. The objective of the manipulation check was to determine if the stimuli chosen for each speeded classification task were adequate.

2.3.2.1. Speeded classification tasks. Two speeded classification tasks were conducted: The *Literal speeded classification task* (Literal SCT) and the *Metaphorical speeded classification task* (Metaphorical SCT). The aim of the Literal SCT was to analyse the effect of displaying an image of fire on classifying product categories congruent or incongruent with the literal meanings of fire (i.e. barbecue, roasted); whereas the aim of the Metaphorical SCT was to analyse the effect of displaying an image of fire on classifying product categories congruent or incongruent with the metaphorical meaning of fire (i.e. spicy). Thus, the participants' task in the Literal SCT was to classify, as quickly and accurately as possible, if the product shown on the screen *could be barbecued, have barbecue flavour or be roasted* vs. *cannot be barbecued, have barbecue flavour or be roasted*. On the other hand, in the Metaphorical SCT participants had to quickly and accurately classify if the product shown on the screen *is spicy/could be marketed as spicy* vs. *is not spicy or could not be marketed as spicy*. A within-subject design was followed, so that all the participants performed both the Literal SCT and the Metaphorical SCT. The task that each participant had to perform first was randomly assigned, and a distractor task was conducted between both SCTs in order to avoid priming (Johnston & Dark, 1986). The structure of both tasks was identical and was designed following the Semin and Palma (2014) procedure.

At the beginning of each SCT a screen with instructions was displayed indicating how the product categories should be classified. Responses were given by pressing either the E or the I keys on the keyboard. The response keys were counterbalanced across participants, so that in each SCT half of the participants classified a set of products with one key and the other set with the other. At the beginning of each trial, a grey (R:159, G:159, B:159) fixation cross on a dark background was shown for 500 ms. Next, the name of a product category was displayed for 1000 ms, at which time the participant had to give an answer. A response window of 1000 ms was established after pretesting with volunteers who did not participate in the final experiment. If participants made an error or did not answer within 1000 ms, feedback of a red cross on the screen was shown. After each response, a dark screen was displayed for 500 ms. In total, each SCT consisted of 64 trials. Each SCT was preceded by a set of 8 practice trials with 2 products corresponding to one category and 2 products corresponding to the other, which did not appear in the main trials and were not analysed.

2.3.2.2. Manipulation check. Once both the Literal SCT and the Metaphorical SCT were completed, the participants performed a manipulation check by answering a questionnaire in order to verify that the product categories selected as congruent and incongruent for each task really were so. The participants indicated the degree of congruence of each of the product categories shown in each speeded classification task with both the literal and metaphorical meanings of fire, indicating whether or not they agreed with the following sentences: *This product can be barbecued, have barbecue flavour or be roasted* (congruency with the literal meaning) and *This product can be spicy* (congruency with the metaphorical meaning).

Table 1
Product categories used in the speeded classification tasks.

Literal SCT (literal meaning; i.e. barbecued, roasted)		Metaphorical SCT (metaphorical meaning; i.e. spicy)	
Congruent	Incongruent	Congruent	Incongruent
Skewers	Mineral water	Peanuts	Mineral water
Peanuts	Salad	Cayenne pepper	Strawberries
Burger	Strawberries	Chili pepper	Lemonade
Potato chips	*Gazpacho*[1]	Potato chips	Ice cream
Sliced turkey	Lettuce	Kebab	Milk
Kebab	Melon	*Salsa brava*[2]	Lettuce
Ribs	Whipped cream	Tabasco	Whipped cream
Sausages	Grapes	Wasabi	Natural yoghurt

[1] A cold soup well known in Spain.
[2] A spicy pepper sauce well known in Spain.

2.3.3. Apparatus and materials

The test took place in a quiet room with stable and homogeneous conditions of light and temperature. Upon arrival, each participant was seated in a single cubicle about 50 cm in front of a 17″ CRT monitor with a resolution of 1366 × 768 px and a refresh rate of 60 Hz, and performed the experiment following the instructions shown on the screen. OpenSesame 3.1.9 software was used to present the stimuli and collect the data (Mathôt, Schreij, & Theeuwes, 2012).

In each speeded classification task, a total of 16 product categories had to be classified, of which 8 were congruent and 8 were incongruent with the corresponding meaning (Table 1). The product categories selected as congruent and incongruent for each task were selected and agreed upon by a panel of 3 experts before conducting the experiment (and subsequently evaluated with a manipulation check, see next section). Care was taken so that the size of the names was as homogeneous as possible between categories. Each of the 16 products could be displayed either together with a fire image or on their own, resulting in a total of 32 stimuli for each task. Each stimulus consisted of the name of the product category displayed in grey (R:159, G:159, B:159), upper case Open Sans Condensed 40pt font against a dark background. The stimuli with fire had an image of fire placed above the category name (Fig. 2). Care was taken so that the fire image size was always the same. The stimuli were designed with Adobe Photoshop CC 2017.1.1 (Adobe Systems Incorporated, 2006). Each of the 32 stimuli shown in each task was shown twice, resulting in a total of 64 trials per task (128 trials in the whole experiment, including the 64 trials of the Literal SCT and the 64 trials of the Metaphorical SCT). Trial order was randomised across participants in each task.

2.3.4. Data analyses

2.3.4.1. Manipulation check. The congruency of the products chosen to be displayed in each task with the corresponding meaning of fire (i.e. the literal meanings in the Literal SCT or the metaphorical meaning in the Metaphorical SCT) was analysed separately by means of a chi-square in contingency tables. In addition, in order to check if the product categories chosen to be classified as congruent/incongruent could be subsequently analysed as single congruent/incongruent product category sets, a Ward's hierarchical cluster analysis using squared Euclidean distances as proximity measures was conducted for the product categories of each SCT.

2.3.4.2. Effect of congruency between fire image meaning and product category on classification easiness. The data of each SCT was analysed

Fig. 2. Examples of the stimuli (salad, tabasco, and skewers, from left to right) without fire (above) and with fire (below) used in the speeded classification tasks.

separately in a 2 × 2 repeated measures ANOVA with product category congruency (congruent, incongruent) and fire depiction (with fire, without fire) as the two factors and the mean reaction time (RT) required to classify each product category as the dependent variable (measured in ms). The RTs of the incorrect trials (i.e. wrong answers and participants who did not respond within 1000 ms, 12.62% in the Literal SCT and 11.85% in the Metaphorical SCT) or who deviated by more than 3 standard deviations from the participants' conditional mean (0.79% of the correct answers in the Literal SCT and 0.65% of the correct answers in the Metaphorical SCT) were excluded from the analyses (Semin & Palma, 2014).

2.3.4.3. Effect of fire image rhetorical style on the cognitive effort required to process it. A one-way repeated measures ANCOVA was conducted in order to verify if the mean RTs needed to classify the congruent products shown with fire in the Literal SCT was lower than the mean RTs needed to classify the congruent products shown with fire in the Metaphorical SCT. As the congruent products classified in each SCT were not the same, there is a risk that the products used in one task were easier to classify than those used in the other task. To eliminate this possible effect, the difference between the RTs of the congruent products shown without fire in both SCTs was included as a covariate ($\Delta = RT_{\text{congruent without fire (Literal SCT)}} - RT_{\text{congruent without fire (Metaphorical SCT)}}$).

In all cases, effects were considered statistically significant when $p < 0.05$. The data was processed and analysed by using SPSS Statistics 23 (Armonk, NY, USA).

3. Results

3.1. Manipulation check

3.1.1. Literal SCT stimuli

A chi-square test was done to analyse the congruence of the products chosen to be classified as congruent or incongruent with the literal meanings of fire (i.e. barbecue, roasted) in the Literal SCT. The chi-square association was statistically significant ($\chi^2 = 922$, $p < 0.001$; Table 2), indicating that the selection of products was adequate. Thus, the response latencies for all products were analysed.

The results of the cluster analysis revealed that the eight product categories chosen to be classified as congruent with the literal meanings of fire made up a single congruent cluster, and that the eight product categories chosen to be classified as incongruent with the literal meanings of fire made up a single incongruent cluster (Table 3; see also Dendrogram in Fig. 3a). Thus, the eight congruent product categories were subsequently analysed as a single congruent product category set, whereas the eight incongruent product categories were analysed as a single incongruent product category set.

3.1.2. Metaphorical SCT stimuli

As in the previous case, a chi-square test was done to analyse the congruence of the products chosen to be classified as congruent or incongruent with the metaphorical meanings of fire (i.e. spicy) in the Metaphorical SCT. The chi-square association was statistically significant ($\chi^2 = 859$, $p < 0.001$; Table 4), indicating that the selection of products was also adequate. The response latencies for all products were thus analysed.

The results of the cluster analysis showed that the eight product categories chosen to be classified as congruent with the metaphorical meanings of fire made up a single congruent cluster, and that the eight product categories chosen to be classified as incongruent with the metaphorical meanings of fire made up a single incongruent cluster (Table 5; see also Dendrogram in Fig. 3b). Thus, the eight congruent product categories were subsequently analysed as a single congruent product category set, whereas the eight incongruent product categories were analysed as a single incongruent product category set.

3.2. Effect of congruency between fire image meaning and product category on classification easiness

3.2.1. Literal SCT

For the literal meanings of fire (i.e. barbecue, roasted; assessed in the Literal SCT) the predicted interaction between product category congruency and fire depiction was significant, $F(1,64) = 51.59$, $p < 0.001$, $\eta_p^2 = 0.45$, supporting H3 (Fig. 4a). Participants classified the congruent product categories significantly faster when they were

Table 2
Evaluation of the participants regarding the congruence of each product displayed in the Literal SCT with the literal meanings of fire. *Note:* Figures denote number of subjects. Not all products add up to 65 responses, as some participants left some questions unanswered.

Products proposed as congruent			Products proposed as incongruent		
Product	Congruent	Incongruent	Product	Congruent	Incongruent
Skewers	62 (100%)	0 (0%)	Mineral water	1 (1.6%)	61 (98.4%)
Peanuts	61 (98.4%)	1 (1.6%)	Salad	2 (3.1%)	63 (96.9%)
Burger	65 (100%)	0 (0%)	Strawberries	0 (0%)	65 (100%)
Potato chips	56 (88.9%)	7 (11.1%)	*Gazpacho*	7 (10.8%)	58 (89.2%)
Sliced turkey	62 (96.9%)	2 (3.1%)	Lettuce	1 (1.6%)	63 (98.4%)
Kebab	64 (100%)	0 (0%)	Melon	2 (3.1%)	62 (96.9%)
Ribs	64 (98.5%)	1 (1.5%)	Whipped cream	0 (0%)	64 (100%)
Sausages	65 (100%)	0 (0%)	Grapes	3 (4.7%)	61 (95.3%)

Table 3
Ward's hierarchical cluster analysis of the products chosen as congruent/incongruent with the literal meanings of fire.

Stage	Cluster combined		Coefficients	Stage cluster first appears		Next stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	Strawberries	Whipped cream	.000	0	0	5
2	Kebab	Sausages	.000	0	0	3
3	Skewers	Kebab	.000	0	2	4
4	Skewers	Burger	.000	3	0	6
5	Strawberries	Lettuce	.667	1	0	7
6	Skewers	Ribs	1.467	4	0	8
7	Mineral water	Strawberries	2.300	0	5	10
8	Skewers	Peanuts	3.167	6	0	11
9	Salad	Grapes	4.667	0	0	12
10	Mineral water	Melon	6.367	7	0	12
11	Skewers	Sliced turkey	8.129	8	0	14
12	Mineral water	Salad	10.857	10	9	13
13	Mineral water	*Gazpacho*	15.554	12	0	15
14	Skewers	Potato chips	21.250	11	0	15
15	Skewers	Mineral water	237.625	14	13	0

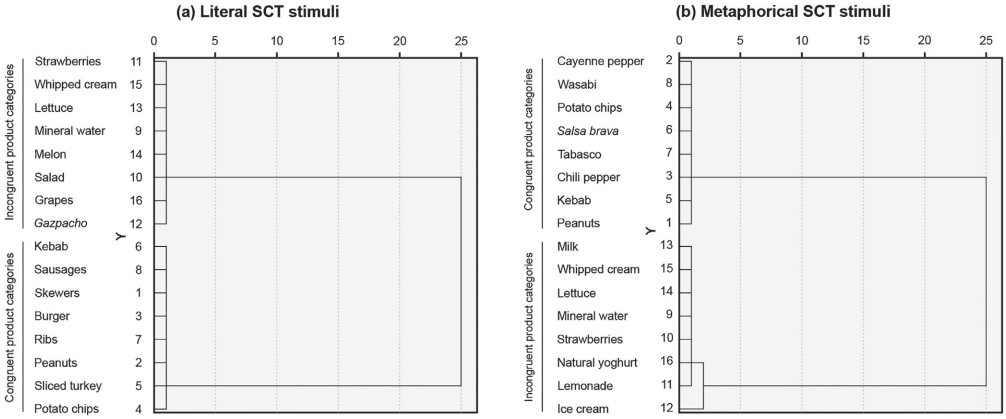

Fig. 3. Dendrogram obtained by means of Ward's hierarchical cluster analysis for the products chosen as congruent/incongruent with the (a) literal meanings of fire (i.e. barbecue, roasted) and (b) metaphorical meaning of fire (i.e. spicy).

displayed with fire ($\bar{X}$ = 584 ms, SD = 51) than when they were displayed without fire ($\bar{X}$ = 605 ms, SD = 59), t(64) = 4.18, p < 0.001. Furthermore, participants classified the incongruent product categories significantly faster when they were displayed without fire ($\bar{X}$ = 567 ms, SD = 44) than when they were displayed with fire ($\bar{X}$ = 602 ms, SD = 44), t(64) = 7.74, p < 0.001. The effect on the response times of depicting fire was greater for the incongruent products than for the congruent products, as the difference in times needed to classify the incongruent products with fire and without fire ($\bar{X}$ = 35 ms, SD = 37) was larger than the difference in the times needed to classify the congruent products with fire and without fire ($\bar{X}$ = 21 ms, SD = 40), t(64) = 2.60, p = 0.012. These results were not influenced by counterbalancing the response keys, as neither of the possible interactions was significant (Congruence × Keys F(1,63) = 0.36, p = 0.55, η_p^2 < 0.01;

Table 4
Evaluation of the participants regarding the congruence of each product displayed in the Metaphorical SCT with the metaphorical meanings of fire. *Note:* Figures denote number of subjects. Not all products add up to 65 responses, as some participants left some questions unanswered.

Products proposed as congruent			Products proposed as incongruent		
Product	Congruent	Incongruent	Product	Congruent	Incongruent
Peanuts	55 (88.7%)	7 (11.3%)	Mineral water	1 (1.6%)	61 (98.4%)
Cayenne pepper	61 (98.4%)	1 (1.6%)	Strawberries	2 (3.1%)	63 (96.9%)
Chili pepper	62 (100%)	0 (0%)	Lemonade	8 (12.3%)	57 (87.7%)
Potato chips	61 (95.3%)	3 (4.7%)	Ice cream	19 (29.2%)	46 (70.8%)
Kebab	64 (100%)	0 (0%)	Milk	0 (0%)	64 (100%)
Salsa brava	65 (100%)	0 (0%)	Lettuce	1 (1.6%)	63 (98.4%)
Tabasco	64 (100%)	0 (0%)	Whipped cream	1 (1.6%)	63 (98.4%)
Wasabi	63 (98.4%)	1 (1.6%)	Natural yoghurt	4 (6.3%)	60 (93.8%)

Table 5
Ward's hierarchical cluster analysis of the products chosen as congruent/incongruent with the metaphorical meanings of fire.

Stage	Cluster combined		Coefficients	Stage cluster first appears		Next stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	Cayenne pepper	Wasabi	.000	0	0	8
2	*Salsa brava*	Tabasco	.000	0	0	3
3	Chili pepper	*Salsa brava*	.000	0	2	4
4	Chili pepper	Kebab	.000	3	0	10
5	Milk	Whipped cream	.500	0	0	6
6	Milk	Lettuce	1.333	5	0	7
7	Mineral water	Milk	2.250	0	6	9
8	Cayenne pepper	Potato chips	3.583	1	0	10
9	Mineral water	Strawberries	5.333	7	0	11
10	Cayenne pepper	Chili pepper	7.429	8	4	12
11	Mineral water	Natural yoghurt	10.595	9	0	13
12	Peanuts	Cayenne pepper	15.917	0	10	15
13	Mineral water	Lemonade	21.321	11	0	14
14	Mineral water	Ice cream	33.750	13	0	15
15	Peanuts	Mineral water	239.000	12	14	0

Fire × Keys $F(1,63) = 1.60$, $p = 0.21$, $\eta_p^2 = 0.025$; Congruence × Fire × Keys $F(1,63) = 2.70$, $p = 0.10$, $\eta_p^2 = 0.04$).

3.2.2. Metaphorical SCT

For the metaphorical meaning of fire (i.e. spicy; assessed in the Metaphorical SCT) the hypothesised interaction between product category congruency and fire depiction was also significant: $F(1,64) = 36.75$, $p < 0.001$, $\eta_p^2 = 0.36$, supporting H3 (Fig. 4b). Participants classified the congruent product categories significantly faster when they were displayed with fire ($\bar{X} = 607$ ms, SD = 69) than when they were displayed without fire ($\bar{X} = 620$ ms, SD = 62), $t(64) = 2.15$, $p = 0.035$. However, participants classified the incongruent product categories significantly faster when they were displayed without fire ($\bar{X} = 578$ ms, SD = 56) than when they were displayed with fire ($\bar{X} = 617$ ms, SD = 54), $t(64) = 7.33$, $p < 0.001$. Similarly to the Literal SCT, the effect of depicting fire on the response times was larger for the incongruent products than for the congruent products, as the difference in the times needed to classify the incongruent products with fire and without fire ($\bar{X} = 38$ ms, SD = 42) was larger than the difference among the times needed to classify the congruent products with fire and without fire ($\bar{X} = 13$ ms, SD = 48), $t(64) = 3.43$, $p < 0.001$. These results were not influenced by counterbalancing the response keys, as neither of the possible interactions was significant (Congruence × Keys $F(1,63) = 3.21$, $p = 0.08$, $\eta_p^2 = 0.05$; Fire × Keys $F(1,63) = 0.73$, $p = 0.40$, $\eta_p^2 = 0.01$; Congruence × Fire × Keys $F(1,63) = 0.18$, $p = 0.68$, $\eta_p^2 < 0.01$).

3.3. Effect of fire image rhetorical style on the cognitive effort required to process it

Regarding the cognitive ease by which participants processed the literal and the metaphorical meanings elicited by the image of fire, the mean RTs of the congruent stimuli displayed with fire in both speeded classification tasks were compared. To exclude the potential confounding effect caused by the use of different products in each task, the difference in the RTs needed to classify the products without fire in each task was used as a covariate. Consistent with H4, the ANCOVA results show that participants needed less time to classify the congruent products when the elicited meaning of fire was literal ($\bar{X} = 584$ ms, SD = 51) than when the elicited meaning of fire was metaphorical ($\bar{X} = 607$ ms, SD = 69), $F(1,63) = 5.34$, $p = 0.024$, $\eta_p^2 = 0.08$; Meaning × Covariate $F(1,63) = 20.19$, $p < 0.001$, $\eta_p^2 = 0.24$.

4. Discussion

The main objectives of this study were to investigate the way an image displayed on a food package influences the associations accessed by the consumer, and to analyse how the rhetorical style of the image (i.e. if its interpretation is literal or metaphorical) influences the cognitive effort necessary to process it. As an example, the case of fire was used and the results show that the image causes meanings congruent with the product in which it is applied to be more accessible from the memory, thus facilitating its categorisation. Conversely, categorisation is hindered if none of the meanings of the image is consistent with the product in which it is applied. In addition, the results also show that an image with a literal rhetorical style requires a lesser cognitive processing effort than an image with a metaphorical rhetorical style.

4.1. Contributions

This research contributes to the literature related to the study of food packaging and consumer research by empirically studying the influence of an image on the associations accessed by the consumer. To date, the specific effect of images shown on packaging in the communication between packaging and consumer has not been thoroughly studied. For example, Smith et al. (2015) showed that having an image on the package of the major taste-giving ingredient instead of a text description makes consumers believe there is a greater proportion of it in the product, while Rebollar et al. (2016) showed that products accompanied with the main product in the serving suggestion shown on a package of fresh cheese influence the time of day it is considered most suitable to consume it. In addition, the same research team showed that communicating that the potato chips contained in a package had been fried in olive oil by showing an image of an oil dispenser instead of by stating in by a text increases the sensory, non-sensory and hedonic expectations of the product and increases the predisposition to buy it (Rebollar et al., 2017). More recently, Gil-Pérez et al. (2019) showed that the interpretation given to an image can be modulated by manipulating the image's shape, since angular fire icons were more associated with spiciness than rounded fire icons (which were rather more associated with roasted flavour). The results reported here help better understand these previous findings by showing the role of congruence in the process of decoding the images shown on a package.

The results of this study can be framed both in the literature related to semantics and language, as well as the processes of categorisation and generation of expectations. According to the findings from these fields, food packaging communicates information to the consumer through its different elements, which act as signs from which the consumer infers meaning (Ares et al., 2011; Piqueras-Fiszman, Ares, & Varela, 2011; Smith et al., 2015) so that the product can be identified and categorised (Loken, 2006; Loken et al., 2008). The images shown on the packaging are an important part of this process (Smith et al.,

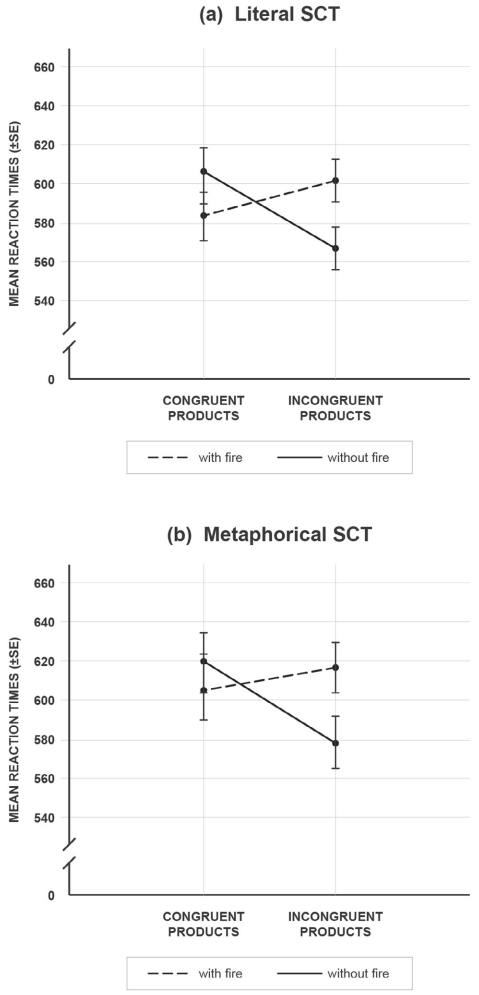

Fig. 4. Mean reaction times in milliseconds as a function of (a) product congruency with the literal meanings of fire (i.e. barbecue, roasted) and the depiction of fire and (b) product congruency with the metaphorical meaning of fire (i.e. spicy) and the depiction of fire (SE = standard error. The error bars indicate 95% confidence intervals).

2015; Underwood & Klein, 2002). According to the principle of relevance (Sperber & Wilson, 1995), consumers assume that the information given by a sign on the packaging is relevant to that context and, therefore, initiate a process by which its meaning is inferred. However, the result of this process is not easily predictable because an image by itself can evoke different meanings in the mind of the observer (Messaris, 1994, 1997; Smith et al., 2015). The results of this study thus add to previous findings that suggest that the presence of congruent signs encourage a faster and easier interpretation in specific directions (e.g. Altmann & Kamide, 1999; Brodbeck & Pylkkänen, 2017; Kleinman, Runnqvist, & Ferreira, 2015; Sedivy, Tanenhaus, Chambers, & Carlson, 1999; cf. Pickering & Gambi, in press), and show that the consumer's mind searches for possible congruent combinations between the image and the product to break the image's intrinsic propositional indeterminacy. In the same way an image is propositionally indeterminate because it can give rise to different interpretations (Smith et al., 2015), the product category is also indeterminate in the absence of any further information. While showing an image of fire on a food container may mean that the product is barbecued, roasted or spicy, the product 'pickles' may be fine herbs, bittersweet or spicy (just to name a few). If a consistent combination among all these options is found in the consumer's memory (in this example, the spicy meaning is congruent with both 'fire' and 'pickles'), the association between the two concepts is activated and that meaning is made accessible. On the other hand, if no consistent combination between image and product is found in the consumer's memory (as in the case of fire and yogurt), the cognitive effort increases to try to make sense of the pairing. Thus, in line with Sperber and Wilson's principle of relevance (Sperber & Wilson, 1995), our results indicate that the presence of the image in a free elicitation task makes concepts accessible from the memory that are not accessible if it is absent (see also González et al., 2006). Our results also show that, in a speeded classification task, there is an interaction between the congruence of the product and the presence of the image, despite the fact that the participants did not receive any indication as to how to react to this image. This suggest that the image generates its own connotative meaning, which is processed independently of that generated by the product category in which it is applied (Ares et al., 2011; Piqueras-Fiszman et al., 2011).

These results also agree with the findings of previous research in the processing differences between words and images. The different experiments in studies such as those by Potter and Faulconer (1975), Pellegrino et al. (1977) and Lewis and Walker (1989) show that both displaying images next to the text (Pellegrino et al., 1977; Potter & Faulconer, 1975) and the visual typeface features of the text (Lewis & Walker, 1989) produce interactions similar to the one reported in this research. In fact, according to Doyle and Bottomley (2004), a generalised result of these studies is that images access a semantic meaning stored in the consumer's memory faster than words, which is usually interpreted as the processing routes for both elements being independent of each other. Therefore, the impact of combining an incongruent image with a congruent text in a speeded classification task is greater than the effect of combining an incongruent text with a congruent image (Lewis & Walker, 1989). The results of this research support these premises since, in the two speeded classification tasks, the impact of showing the fire image (measured as the difference between the latencies necessary to classify the products with or without the image) was significantly greater when classifying incongruent products than when classifying congruent products.

In addition, this study experimentally shows that decoding an image with a literal meaning requires less cognitive effort than decoding an image with a metaphorical meaning, indicating that the rhetorical style of an image influences the way it is processed. This result agrees with the existing literature, as it is considered that processing a metaphorical message from a cognitive point of view requires more effort than processing a literal message, as it evokes a set of more complex semantic associations in the memory of the observer (Gentner, 1983; Jeong, 2008). In other words, implicit visual arguments require a greater cognitive process and preparation (Messaris, 1997), so that it can be assumed they have a lower processing fluency than literal messages. Although a lower processing fluency is related to a worse overall attitude of the consumer towards the product (Alter & Oppenheimer, 2009; Lee & Labroo, 2004), studies that analyse how the use of metaphors influences consumer response show that their use improves the attitude towards the brand and the product (McQuarrie & Mick, 2003; McQuarrie & Phillips, 2005; Phillips & McQuarrie, 2009). This is explained because solving the puzzle that the metaphor poses is stimulating and rewarding (Fenko et al., 2018; Machiels & Karnal, 2016) unless it is too difficult (McQuarrie & Mick, 1999; van Rompay &

Veltkamp, 2014). In the case of this experiment, the metaphor 'spiciness is fire' is successful due to the perception of the increased temperature that occurs in the mouth when eating spicy foods (Caterina et al., 1997; Tu et al., 2016), and this is well known and recognisable to observers for it to be considered a cognitive challenge to them (which explains why the difference in processing found between the literal and metaphorical meanings of fire is modest).

4.2. Limitations and future research

Beyond its contributions, this study has some limitations that must be taken into account. For example, there may be a bias in the main study regarding the diversity and features of the participants. All participants were university students living in the same country (Spain). As a result, further testing would be needed to see if these results could be extrapolated to other markets and other cohorts of consumers and to check if individual differences exist (Lidón et al., in press; Piqueras-Fiszman et al., 2011). In addition, while we believe that the results of the second pretest suggest that the presence of the image in a free elicitation task makes concepts accessible from the memory that are not accessible if it is absent, it may be argued that in the case of pickles the 'spicy' concept is not accessible without the image of fire because they are interpreted as "normal" pickles (which are usually not spicy). It may be worth to do further research in this regard studying how a given image favours the elicitation of an attribute shared by all the stimuli studied (e.g. vinegar flavour, which is usually shared by all pickles). Moreover, it should be highlighted that although the term 'literal' is used throughout this paper to refer to meanings directly related to fire (such as *barbecue* or *roast*), it would be more correct to refer to it as a case of metonymy, where the cause stands for the effect (i.e. the image of fire is used to mean an effect of it). However, the term 'literal' was used in order to intuitively distinguish the meanings directly related to fire from the metaphorical ones (such as *spicy*).

It is worth noting that several products used as being congruent with the meaning assessed in one of the speeded classification tasks may also be congruent with the meaning assessed in the other one (e.g. skewers, peanuts or burgers may be considered as being congruent both with the literal and with the metaphorical meanings of fire), which may raise some concern about the validity of these results. It could be argued that one product being congruent with other meanings that the ones being assessed in a given task may lead to confusion or a higher cognitive load, which in turn may tarnish response times. However, it should be noted that the order of the speeded classification tasks was randomised and that when participants performed the first speeded classification task they did not know that there was going to be another one (and therefore, another meaning to assess), so the chance of being influenced by it (or by any other alternative concept to the one being assessed in the first one) is modest. For example, in the Metaphorical speeded classification task participants just had to classify products as being spicy or not, and no reference was made to concepts like barbecue or roast (which were assessed in the Literal speeded classification task).

On the other hand, different products were used in each speeded classification task to ensure that the products chosen for each one represented unequivocally congruent and incongruent choices with the assessed meaning (literal or metaphorical), which implied that there could be internal differences within each group of products in terms of ease or difficulty of processing, understanding or readability. Although it can be argued that this makes it difficult to analyse data as sets of congruent/incongruent product categories as it has been done in this study, a panel of 3 experts agreed on the product categories before conducting the speeded classification tasks and a manipulation check was carried out in order to verify that this could be done. Indeed, the results of the manipulation check reveal that the product categories considered as being congruent or incongruent with each meaning of fire made up robust clusters, making it possible to analyse them jointly rather than by individual product categories.

Finally, it could also be argued that the fact that different product categories were displayed in each speeded classification task makes impossible to compare the response times of the products displayed with fire on each, so that it would not be possible to assess if, as hypothesised, the metaphorical rhetorical style takes more time to process that the literal rhetorical style. To solve this problem, an ANCOVA was carried out in which the difference between the time needed to classify the products displayed without fire in each speeded classification task was included as a covariate. However, despite all the precautions taken, we believe it is necessary to consider all these aspects as limitations of this study.

Moreover, it is important to emphasise that one must be cautious about drawing conclusions from the study results related to the hedonic and affective response of the consumer to the product. The processing fluency literature suggests that a lower cognitive effort is related to greater fluency and a better consumer attitude (Alter & Oppenheimer, 2009), although it is not clear that the latencies of a speeded classification task, such as the one used in this experiment, really represent processing fluency (Graf, Mayer, & Landwehr, 2017). On the other hand, while several studies suggest that displaying an incongruent association on the package may improve the consumer's attitude toward the product, due to the surprise or interest it may generate (Heckler & Childers, 1992; Van Rompay & Pruyn, 2011; van Rompay, Pruyn, & Tieke, 2009), others warn that showing information considered irrelevant can negatively influence consumer expectations (Meyvis & Janiszewski, 2002). Further research is needed from these results in order to better understand the relationship between the response latencies of a speeded classification task and the hedonic and affective responses of the consumer.

This study leaves some unanswered questions that open the door to future lines of research. For example, this research shows that the consumer relies on the congruence of possible meanings for the image with possible features of the image by studying when a fire image evokes literal meanings (barbecue, roast) and when it evokes a metaphorical one (spiciness). However, it does not address how the consumer decides which of the literal meanings is appropriate for a given product. Although it can be assumed that the process will be the same and will be based on the congruence of each of them with the product (e.g., we may expect that while displaying a fire image on a bread package transmits *roasted*, showing a fire image on a veal fillet would suggest *barbecue*), experimental analysis would be needed to verify if this is the case. Moving forward in this direction would allow for a better understanding of the factors responsible for the consumer assigning meanings to images displayed on food packaging.

5. Conclusion

An image shown on a food package label helps the consumer categorise the product and contribute to the process of generating expectations, as the consumer's brain tries to assign meaning to it. This investigation shows that, when a possible meaning of the image is consistent with the product to which it is applied, the association between the two is strengthened and the consumer finds it easier to categorise the product. However, showing an incongruent image with the product confuses the consumer and makes it difficult to understand, thus increasing the time needed to categorise it. The research results also show that the rhetorical style of an image influences the cognitive effort needed to process it, since a literal interpretation of an image allows for access to its meaning more quickly than a metaphorical one.

These results are of interest to producers, designers and legislators, since help to improve our understanding of the process by which consumers interpret messages elicited by food packaging and enable the design of packages which are more understandable and easy to interpret.

References

Alter, A. L., & Oppenheimer, D. M. (2009). Uniting the tribes of fluency to form a metacognitive nation. *Personality and Social Psychology Review, 13*(3), 219–235. https://doi.org/10.1177/1088868309341564.

Altmann, G. T. M., & Kamide, Y. (1999). Incremental interpretation at verbs: Restricting the domain of subsequent reference. *Cognition, 73*(3), 247–264. https://doi.org/10.1016/S0010-0277(99)00059-1.

Ares, G., Piqueras-Fiszman, B., Varela, P., Marco, R. M., López, A. M., & Fiszman, S. (2011). Food labels: Do consumers perceive what semiotics want to convey? *Food Quality and Preference, 22*(7), 689–698. https://doi.org/10.1016/j.foodqual.2011.05.006.

Azzi, A., Battini, D., Persona, A., & Sgarbossa, F. (2012). Packaging design: General framework and research agenda. *Packaging Technology and Science, 25*, 435–456. https://doi.org/10.1002/pts.993.

Barthes, R. (1977). *Image music text.* New York: Hill and Wang.

Brodbeck, C., & Pylkkänen, L. (2017). Language in context: Characterizing the comprehension of referential expressions with MEG. *NeuroImage, 147*(September 2016), 447–460. https://doi.org/10.1016/j.neuroimage.2016.12.006.

Caterina, M., Schumacher, M., Timinaga, M., & Rosen, T. (1997). The capsaicin receptor: A heat-activited ion channel in the pathway. *Nature, 389*(October), 816–824. https://doi.org/10.1038/39807.

Celhay, F., & Remaud, H. (2018). What does your wine label mean to consumers? A semiotic investigation of Bordeaux wine visual codes. *Food Quality and Preference, 65*(November 2017), 129–145. https://doi.org/10.1016/j.foodqual.2017.10.020.

Deliza, R., & MacFie, H. J. H. (1996). The generation of sensory expectation by external cues and its effect on sensory perception and hedonic ratings: A review. *Journal of Sensory Studies, 11*(2), 103–128. https://doi.org/10.1111/j.1745-459X.1996.tb00036.x.

Doyle, J. R., & Bottomley, P. A. (2004). Font appropriateness and brand choice. *Journal of Business Research, 57*(8), 873–880. https://doi.org/10.1016/S0148-2963(02)00487-3.

Epley, N., & Gilovich, T. (2006). The anchoring-and-adjustment heuristic why the adjustments are insufficient. *Psychological Science, 17*(4), 311–319.

Estes, Z., & Jones, L. L. (2006). Priming via relational similarity: A copper horse is faster when seen through a glass eye. *Journal of Memory and Language, 55*(1), 89–101. https://doi.org/10.1016/j.jml.2006.01.004.

Fenko, A., Vries, R. De, & Rompay, T. Van (2018). How strong is your coffee? The influence of visual metaphors and textual claims on consumers' flavor perception and product evaluation. *Frontiers in Psychology, 9*(February), 1–12. https://doi.org/10.3389/fpsyg.2018.00053.

Festila, A., & Chrysochou, P. (2018). Implicit communication of food product healthfulness through package design: A content analysis. *Journal of Consumer Behaviour,* (February 2017), 1–16. https://doi.org/10.1002/cb.1732.

Fillmore, C. J., & Baker, C. (2010). A frames approach to semantic analysis. In B. Heine, & H. Narrog (Eds.). *The Oxford Handbook of Linguistic Analysis* (pp. 313–340). Oxford: Oxford University Press.

Gagné, C. L., & Spalding, T. L. (2006). Using conceptual combination research to better understand novel compound words. *SKASE Journal of Theoretical Linguistics, 3*(2), 9–16.

Gentner, D. (1983). Structure mapping: A theoretical framework for analogy. *Cognitive Science, 7*(2), 155–170. https://doi.org/10.1016/S0364-0213(83)80009-3.

Gil-Pérez, I., Rebollar, R., Lidón, I., Martín, J., van Trijp, H. C. M., & Piqueras-Fiszman, B. (2019). Hot or not? Conveying sensory information on food packaging through the spiciness-shape correspondence. *Food Quality and Preference, 71*(July 2018), 197–208. https://doi.org/10.1016/j.foodqual.2018.07.009.

González, J., Barros-Loscertales, A., Pulvermüller, F., Meseguer, V., Sanjuán, A., Belloch, V., & Ávila, C. (2006). Reading cinnamon activates olfactory brain regions. *NeuroImage, 32*(2), 906–912. https://doi.org/10.1016/j.neuroimage.2006.03.037.

Graf, L. K. M., Mayer, S., & Landwehr, J. R. (2017). Measuring processing fluency: One versus five items. *Journal of Consumer Psychology*. https://doi.org/10.1002/jcpy.1021.

Gregan-Paxton, J., & John, D. R. (1997). Consumer learning by analogy: A model of internal knowledge transfer. *Journal of Consumer Research, 24*(3), 266–284. https://doi.org/10.1086/209509.

Heckler, S. E., & Childers, T. L. (1992). The role of expectancy and relevancy in memory for verbal and visual information: What is incongruency? *Journal of Consumer Research, 18*(4), 475. https://doi.org/10.1086/209275.

Honea, H., & Horsky, S. (2012). The power of plain: Intensifying product experience with neutral aesthetic context. *Marketing Letters, 23*(1), 223–235. https://doi.org/10.1007/s11002-011-9149-y.

Jeong, S. H. (2008). Visual metaphor in advertising: Is the persuasive effect attributable to visual argumentation or metaphorical rhetoric? *Journal of Marketing Communications, 14*(1), 59–73. https://doi.org/10.1080/14697010701717488.

Johnston, W. A., & Dark, V. J. (1986). Selective attention. *Annual Review of Psychology, 37*(1), 43–75. https://doi.org/10.1146/annurev.ps.37.020186.000355.

Kauppinen-Räisänen, H. (2014). Strategic use of colour in brand packaging. *Packaging Technology and Science, 27*(8), 663–676. https://doi.org/10.1002/pts.2061.

Kleinman, D., Runnqvist, E., & Ferreira, V. S. (2015). Single-word predictions of upcoming language during comprehension: Evidence from the cumulative semantic interference task. *Cognitive Psychology, 79*, 68–101. https://doi.org/10.1016/j.cogpsych.2015.04.001.

Lähteenmäki, L. (2013). Claiming health in food products. *Food Quality and Preference, 27*(2), 196–201. https://doi.org/10.1016/j.foodqual.2012.03.006.

Lee, A. Y., & Labroo, A. A. (2004). The effect of conceptual and perceptual fluency on brand evaluation. *Journal of Marketing Research, 41*(2), 151–165. https://doi.org/10.1509/jmkr.41.2.151.28665.

Lewis, C., & Walker, P. (1989). Typographic influences on reading. *British Journal of Psychology, 80*(2), 241–257. https://doi.org/10.1111/j.2044-8295.1989.tb02317.x.

Lidón, I., Rebollar, R., Gil-Pérez, I., Martín, J., & Vicente-Villardón, J. L. (in press). The influence the image of the product shown on food packaging labels has on product perception during tasting: Effects and gender differences. *Packaging Technology and Science*. https://doi.org/10.1002/pts.2407.

Loken, B. (2006). Consumer psychology: Categorization, inferences, affect, and persuasion. *Annual Review of Psychology, 57*(1), 453–485. https://doi.org/10.1146/annurev.psych.57.102904.190136.

Loken, B., Barsalou, L. W., & Joiner, C. (2008). Categorzation theory and research in consumer psychology: Category representation and category-based inference. *Handbook of Consumer Psychology,* 133–163.

Lynott, D., & Connell, L. (2010). Embodied conceptual combination. *Frontiers in Psychology, 1*(NOV), 1–14. https://doi.org/10.3389/fpsyg.2010.00212.

Machiels, C. J. A., & Karnal, N. (2016). See how tasty it is? Effects of symbolic cues on product evaluation and taste. *Food Quality and Preference, 52*, 195–202. https://doi.org/10.1016/j.foodqual.2016.04.014.

Madzharov, A. V., & Block, L. G. (2010). Effects of product unit image on consumption of snack foods. *Journal of Consumer Psychology, 20*(4), 398–409. https://doi.org/10.1016/j.jcps.2010.06.007.

Magnier, L., & Schoormans, J. (2017). How do packaging material, colour and environmental claim influence package, brand and product evaluations? *Packaging Technology and Science*. https://doi.org/10.1002/pts.2318.

Mathôt, S., Schreij, D., & Theeuwes, J. (2012). OpenSesame: An open-source, graphical experiment builder for the social sciences. *Behavior Research Methods, 44*(2), 314–324. https://doi.org/10.3758/s13428-011-0168-7.

McQuarrie, E. F., & Mick, D. G. (1999). Visual Rhetoric in advertising: Text-interpretive, experimental, and reader-response analyses. *Journal of Consumer Research, 26*(1), 37–54. https://doi.org/10.1086/209549.

McQuarrie, E. F., & Mick, D. G. (2003). Visual and verbal rhetorical figures under directed processing versus incidental exposure to advertising. *Journal of Consumer Research, 29*(4), 579–587. https://doi.org/10.1086/346252.

McQuarrie, E. F., & Phillips, B. J. (2005). Indirect persuasion in advertising: How consumers process metaphors presented in pictures and words. *Journal of Advertising, 34*(2), 7–20. https://doi.org/10.1080/00913367.2005.10639188.

Messaris, P. (1994). *Visual literacy: Image, mind, and reality.* Boulder: Westview Press.

Messaris, P. (1997). *Visual persuasion: The role of images in advertising.* Thousand Oaks, CA: Sage Publications.

Meyvis, T., & Janiszewski, C. (2002). Consumers' beliefs about product benefits: The effect of obviously irrelevant product information. *Journal of Consumer Research, 28*(4), 618–635. https://doi.org/10.1086/338205.

Miller, G. L., Malhotra, N. K., & King, T. M. (2006). Categorization. In N. K. Malhotra (Ed.). *Review of Marketing Research (Review of Marketing Research, Volume 2)* (pp. 109–150). Emerald Group Publishing Limited.

Mueller, S., Lockshin, L., & Louviere, J. J. (2009). What you see may not be what you get: Asking consumers what matters may not reflect what they choose. *Marketing Letters, 21*(4), 335–350. https://doi.org/10.1007/s11002-009-9098-x.

Mumani, A., & Stone, R. (2018). State of the art of user packaging interaction (UPI). *Packaging Technology and Science,* (November 2017), 1–19. https://doi.org/10.1002/pts.2363.

Peirce, C. S. (1991). *Peirce on signs: Writings on semiotic.* Chapel Hill: University of North Carolina Press.

Pellegrino, J. W., Rosinski, R. R., Chiesi, H. L., & Siegel, A. (1977). Picture-word differences in decision latency: An analysis of single and dual memory models. *Memory & Cognition, 5*(4), 383–396. https://doi.org/10.3758/BF03197377.

Phillips, B. J. (2000). The impact of verbal anchoring on consumer response to image ads. *Journal of Advertising, 29*(1), 15–24. https://doi.org/10.1080/00913367.2000.10673600.

Phillips, B., & McQuarrie, E. F. (2002). The development, change and transformation of rhetorical style in magazine advertisements, 1994–1999. *Journal of Advertising, 31*(4), 1–13.

Phillips, B. J., & McQuarrie, E. F. (2009). Impact of advertising metaphor on consumer belief. *Journal of Advertising, 38*(1), 49–61.

Pickering, M. J., & Gambi, C. (in press). Predicting While Comprehending Language: A Theory and Review. *Psychological Bulletin*. https://doi.org/10.1037/bul0000158.

Piqueras-Fiszman, B., Ares, G., & Varela, P. (2011). Semiotics and perception: Do labels convey the same messages to older and younger consumers? *Journal of Sensory Studies, 26*(3), 197–208. https://doi.org/10.1111/j.1745-459X.2011.00336.x.

Piqueras-Fiszman, B., & Spence, C. (2015). Sensory expectations based on product-extrinsic food cues: An interdisciplinary review of the empirical evidence and theoretical accounts. *Food Quality and Preference, 40*(PA), 165–179. https://doi.org/10.1016/j.foodqual.2014.09.013.

Potter, M., & Faulconer, B. (1975). Time to understand picture and words. *Nature, 253*(1972), 437–438.

Rebollar, R., Gil, I., Lidón, I., Martín, J., Fernández, M. J., & Rivera, S. (2017). How material, visual and verbal cues on packaging influence consumer expectations and willingness to buy: The case of crisps (potato chips) in Spain. *Food Research International, 99*, 239–246. https://doi.org/10.1016/j.foodres.2017.05.024.

Rebollar, R., Lidón, I., Gil, I., Martín, J., Fernández, M. J., & Riveres, C. E. (2016). The influence the serving suggestion displayed on soft cheese packaging has on consumer expectations and willingness to buy. *Food Quality and Preference, 52*, 188–194. https://doi.org/10.1016/j.foodqual.2016.04.015.

Schifferstein, H. N. J. (2001). Effects of product beliefs on product perception and liking. In L. Frewer, E. Risvik, & H. Schifferstein (Eds.). *Food, people and society: A European*

perspective of consumers' food choices (pp. 73–96). Berlin: Springer Verlag.
Sedivy, J. C., Tanenhaus, M. K., Chambers, C. G., & Carlson, G. N. (1999). Achieving incremental semantic interpretation through contextual representation. *Cognition, 71*(2), 109–147. https://doi.org/10.1016/S0010-0277(99)00025-6.
Semin, G. R., & Palma, T. A. (2014). Why the bride wears white: Grounding gender with brightness. *Journal of Consumer Psychology, 24*(2), 217–225. https://doi.org/10.1016/j.jcps.2013.09.003.
Silayoi, P., & Speece, M. (2007). The importance of packaging attributes: A conjoint analysis approach. *European Journal of Marketing, 41*(11/12), 1495–1517. https://doi.org/10.1108/03090560710821279.
Smith, V., Barratt, D., & Selsøe Sørensen, H. (2015). Do natural pictures mean natural tastes? Assessing visual semantics experimentally. *Cognitive Semiotics, 8*(1), 53–86. https://doi.org/10.1515/cogsem-2015-0001.
Smith, M. C., & Magee, L. E. (1980). Tracing the time course of picture-word processing. *Journal of Experimental Psychology: General, 109*(4), 373–392. https://doi.org/10.1037/0096-3445.109.4.373.
Smith, V., Møgelvang-Hansen, P., & Hyldig, G. (2010). Spin versus fair speak in food labelling: A matter of taste? *Food Quality and Preference, 21*(8), 1016–1025. https://doi.org/10.1016/j.foodqual.2010.05.016.
Smith, E. E., Osherson, D. N., Rips, L. J., & Keane, M. (1988). Combining prototypes: A selective modification model. *Cognitive Science, 12*(4), 485–527. https://doi.org/10.1016/0364-0213(88)90011-0.
Spence, C. (2018). Background colour & its impact on food perception & behaviour. *Food Quality and Preference, 68*(December 2017), 156–166. https://doi.org/10.1016/j.foodqual.2018.02.012.
Spence, C., & Piqueras-Fiszman, B. (2014). *The perfect meal: The multisensory science of food and dining.* Chichester, UK: John Wiley & Sons, Ltd.
Sperber, D., & Wilson, D. (1995). *Relevance: Communication and cognition.* Malden: Blackwell Publishing.
Sütterlin, B., & Siegrist, M. (2015). Simply adding the word "fruit" makes sugar healthier: The misleading effect of symbolic information on the perceived healthiness of food. *Appetite, 95*, 252–261. https://doi.org/10.1016/j.appet.2015.07.011.
Tu, Y., Yang, Z., & Ma, C. (2016). The taste of plate: How the spiciness of food is affected by the color of the plate used to serve it. *Journal of Sensory Studies, 31*(1), 50–60. https://doi.org/10.1111/joss.12190.
Underwood, R. L., & Klein, N. M. (2002). Packaging as brand communication: Effects of product pictures on consumer responses to the package and brand. *Journal of Marketing Theory and Practice, 10*(4), 58–68. https://doi.org/10.1080/10696679.2002.11501926.
van Jaarsveld, H. J., Coolen, R., & Schreuder, R. (1994). The role of analogy in the interpretation of novel compounds. *Journal of Psycholinguistic Research, 23*(2), 111–137. https://doi.org/10.1007/BF02143919.
Van Rompay, T. J. L., & Pruyn, A. T. H. (2011). When visual product features speak the same language: Effects of shape-typeface congruence on brand perception and price expectations. *Journal of Product Innovation Management, 28*(4), 599–610. https://doi.org/10.1111/j.1540-5885.2011.00828.x.
van Rompay, T. J. L., Pruyn, A. T. H., & Tieke, P. (2009). Symbolic meaning integration in design and its influence on product and brand evaluation. *International Journal of Design, 3*(2), 19–26.
van Rompay, T. J. L., & Veltkamp, M. (2014). Product packaging metaphors: Effects of ambiguity and explanatory information on consumer appreciation and brand perception. *Psychology & Marketing, 31*(6), 404–415. https://doi.org/10.1002/mar.20703.
Venter, K., van der Merwe, D., de Beer, H., Kempen, E., & Bosman, M. (2011). Consumers' perceptions of food packaging: An exploratory investigation in Potchefstroom, South Africa. *International Journal of Consumer Studies, 35*(3), 273–281. https://doi.org/10.1111/j.1470-6431.2010.00936.x.

3.6. Study 6

Gil-Pérez, I., Rebollar, R., Lidón, I., Martín, J., van Trijp, H. C. M., & Piqueras-Fiszman, B. (2019). Hot or not? Conveying sensory information on food packaging through the spiciness-shape correspondence. *Food Quality and Preference*, *71*, 197–208. https://doi.org/10.1016/j.foodqual.2018.07.009

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Hot or not? Conveying sensory information on food packaging through the spiciness-shape correspondence

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ABSTRACT

The packaging of a product is a key element in the communication between producers and consumers, so getting the consumer to interpret the packaging visual signs in the desired way is crucial to be successful in the marketplace. However, this is not easy as images can be ambiguous and may be interpreted in different ways. For example, depicting an icon of fire on the front of a bag of nuts may lead the consumer to interpret either that the nuts are spicy or that the nuts have been roasted. This paper addresses this problem and, using this case as an example, assesses if the interpretation of a fire icon (spicy vs roasted) can be modulated by manipulating its shape (angular vs rounded). 66 participants carried out an experiment which results show that there is a crossmodal correspondence between spiciness and pointy shapes and that this association can be used to modulate sensory expectations: in a speeded classification task, the bags of nuts depicting pointy fire icons were categorised more quickly as being spicy than as being roasted, while the opposite was true for the bags of nuts displaying rounded fire icons. In addition, the results of a mediation analysis suggest that this effect occurs indirectly through affective appraisal: the pointy fire icons were judged as being more aggressive than the rounded fire icons, which in turn raised spiciness expectations. These findings contribute to the research on crossmodal correspondences and semiotics by showing that the association between spiciness and abstract shapes can be used to modulate how people interpret an ambiguous image.

1. Introduction

One of the main tasks of a packaging designer is to effectively communicate the characteristics of the product contained within, as packaging is an important communication tool between producers and consumers (Nancarrow, Wright, & Brace, 1998). To that end, the designer must understand and untangle the codes and language used by consumers (Frascara, 1988; Laing & Masoodian, 2016) and, in addition, reproduce them clearly in an appealing design (Silayoi & Speece, 2007). Images allow the designer to both communicate messages and gain aesthetic quality, which is why they are frequently used in food packaging (Underwood & Klein, 2002). Images are a key element in the packaging visual appearance as they allow the consumer to quickly identify and categorize the product (Loken, 2006) and to generate expectations about it (see Deliza & MacFie, 1996; Piqueras-Fiszman & Spence, 2015, for reviews). However, for the designer it is not easy to anticipate the meaning that a consumer will assign to an image since in a given context an image can evoke different concepts (Smith, Barratt, & Selsøe Sørensen, 2015): for example, when viewing an icon depicting fire on a bag of nuts the consumer may interpret that the nuts are spicy or that the nuts have been roasted. For both designers and producers it is key to know what does the elicitation of one meaning or another depend on, as previous works suggest that for a product to succeed in the market it should satisfy consumer expectations (Piqueras-Fiszman & Spence, 2015). The investigation reported here addresses this problem by studying if it is possible to use the crossmodal correspondence between spiciness and shapes to favour one of the possible interpretations of the same image, which would allow the designer to gain control over the communication process. Specifically, we argue that the meaning implicitly assigned to an icon of fire depicted on a bag of nuts (i.e. spicy or roasted) depends on the angularity of the icon, and propose that the nature of this effect is affective.

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2. Background

2.1. The image displayed in the package as a propositionally indeterminate semantic sign

The visual appearance of a package plays a key role during the categorisation process and the generation of expectations, since consumers use the different elements of the package as signs from which to infer information (Loken, 2006; Loken, Barsalou, & Joiner, 2008). Based on Peirce (1991), Ares et al. (2011) distinguish two kinds of signs in the context of food packaging: linguistic signs (i.e. signs that produce meaning by social convention, like texts or words) and visual signs (i.e. signs that produce meaning by resemblance, like colours or images). Today we have abundant information regarding the way in which linguistic signs or some visual signs such as colour influence these processes (Kauppinen-Räisänen & Luomala, 2010; Lähteenmäki, 2013; Piqueras-Fiszman & Spence, 2015; Spence & Piqueras-Fiszman, 2014; Sütterlin & Siegrist, 2015). On the contrary, the specific effect of the images in the communication between packaging and consumer has been less studied. For example, Smith et al. (2015) showed that having an image on the package of the major taste-giving ingredient instead of a text description makes consumers believe there is a greater proportion of it in the product, while Rebollar et al. (2016) showed that products accompanied with the main product in the serving suggestion depicted on a package of fresh cheese influence the time of the day it is considered most suitable to consume it. More recent work from the same team suggest that communicating that the potato chips contained in a package had been fried in olive oil by showing an image of an oil dispenser instead of by stating it by a text increases the sensory, non-sensory and hedonic expectations of the product and increases the willingness to buy it (Rebollar et al., 2017).

However, despite the importance of transmitting a clear and unambiguous message to the consumer, the designer cannot easily anticipate the meaning that will be inferred from an image displayed on a food package. An image by itself is propositionally indeterminate and may evoke many interpretations in the mind of the consumer, since it lacks the syntactic devices necessary to emit an explicit propositional meaning (Messaris, 1994, 1997; Smith et al., 2015). For example, consider the case of depicting an image of fire on a bag of nuts: the consumer may interpret that the product is spicy or that the product has been roasted (Smith et al., 2015), as in this context *fire* may be congruently understood in either way. Although this propositional indeterminacy can be broken by making the meaning of the image explicit by using supporting text (Barthes, 1977; Phillips, 2000), the paths by which the meanings of text and image are decoded are different and can lead to different interpretations. In that case, an additional process is required to resolve the conflict and select a definitive meaning (Lewis & Walker, 1989), which may negatively affect the processing fluency and the overall attitude toward the product (Alter & Oppenheimer, 2009). In addition, it is also worth noting that the image captures attention faster than the text (Honea & Horsky, 2012; Silayoi & Speece, 2007; Venter, van der Merwe, de Beer, Kempen, & Bosman, 2011), is processed more quickly (Mueller, Lockshin, & Louviere, 2009; Underwood & Klein, 2002), and that the first impression may condition the response to subsequent stimuli (Epley & Gilovich, 2006; Madzharov & Block, 2010). Thus, effectively controlling the expectations evoked by the image is thus crucial for the designer in order to ensure that the message conveyed by all the signs displayed on the package is congruent.

2.2. Conveying spiciness through the shape of an image

The literature dedicated to crossmodal correspondences gives a hint about why it can be expected that the shape of an image depicted on a food package may influence the sensory expectations of the product contained within. Crossmodal correspondences are the often surprising associations that the majority of people seems to share across stimuli from different sensory modalities (Spence, 2011). Although many of the studies that initially analysed these effects focused on the correspondences between audition and vision (Parise & Spence, 2013; Spence, 2011), crossmodal correspondences have been documented among all sensory modalities (Spence, 2011). Specially regarding the gustatory sense, it has been shown that expected and perceived flavour may be influenced by audition (see Spence, 2015a for a review), touch (Barnett-Cowan, 2010; Piqueras-Fiszman, Harrar, Alcaide, & Spence, 2011) or vision. In this particular case, associations have been found between both flavour and taste and cues as colour (Piqueras-Fiszman & Spence, 2011; Piqueras-Fiszman, Velasco, & Spence, 2012), packaging shape (Becker, van Rompay, Schifferstein, & Galetzka, 2011; Velasco, Salgado-Montejo, Marmolejo-Ramos, & Spence, 2014) or abstract shapes (Liang, Roy, Chen, & Zhang, 2013; Velasco, Woods, Petit, Cheok, & Spence, 2016). However, the majority of the research conducted to date has focused in basic tastes and other components of flavour like the burning sensation of spiciness/piquancy[1] have been barely studied (Wang, Keller, & Spence, 2017).

Literature makes a clear distinction between the concepts of taste and flavour (Spence, Smith, & Auvray, 2014). While the basic tastes include bitter, sweet, salty, sour and umami, and are understood as the specific gustatory sensations that occur with the stimulation of receptors located in the tongue (Delwiche, 1996), flavour is a more complex multisensory perception that is processed from gustatory, olfactory (mainly retronasal) and trigeminal inputs (Spence et al., 2014; Spence, 2015a, 2015b). The trigeminal system is the chemosensory system responsible of mediating sensations as the cool feeling caused by peppermint chewing gum, the tingling produced on the tongue by carbonated drinks or the burning sensation while eating chili peppers (Lundström, Boesveldt, & Albrecht, 2011). The spiciness/piquant sensation that arises when you eat chili peppers or other pungent products is therefore produced by the activation of the trigeminal system receptors located in the mouth when the irritants contained in these products, such as capsaicin, are released. These receptors are the same ones that are responsible for processing temperature, pain and chemical irritation, so the sensation produced by capsaicin is processed by the brain in similar terms to those of an increase in temperature (Caterina, Schumacher, Timinaga, & Rosen, 1997). The intensity of the perceived heat depends on factors such as the concentration of capsaicin present in the food (Baron & Penfield, 1996), time elapsed between intakes (Carstens et al., 2002) or serving temperature (Reinbach, Toft, & Møller, 2009), and usually takes a few tenths of a second to reach its maximum level (Prescott & Stevenson, 1995). Although the spiciness/burning sensation produced by capsaicin is not considered a basic taste, it is described as a significant contributor to flavour perception and has even been described as “the forgotten flavour sense” (Lawless, 1989; Spence, 2015b; Tu, Yang, & Ma, 2016; Viana, 2011). As is the case with other flavour components, people seem to match spiciness with stimuli from other sensory domains such as audition and vision. Thus, both expected and perceived spiciness can be enhanced with specific sound attributes (high pitch, fast tempo or high levels of distortion; Wang et al., 2017), by manipulating the intensity of red colouring of a salsa (the more intense the red, more spicy the salsa; Levitan & Shermer, 2014) or with the colour of the plate on which a food is served (being red the spiciest; Tu et al., 2016).

In recent years there has been a growing interest in understanding shape symbolism within the framework of flavour-vision correspondences (Becker et al., 2011; Velasco et al., 2014; Velasco, Woods, Petit, et al., 2016). However, despite the burning sensation caused by pungent food being considered a significant contributor to flavour

[1] Although the terms *spiciness* or *spicy* may also refer to the aroma of a given food (Spence et al., 2014), in the present paper they are used to describe the burning sensation caused by capsaicin (Caterina et al., 1997).

perception, to date no study has analysed the association between shapes and spiciness. Studies conducted so far show that rounded forms tend to be associated with sweet tastes, while angular forms are more commonly associated with bitter or acidic foods (Liang et al., 2013; Velasco et al., 2014; Velasco, Woods, Deroy, & Spence, 2015; Velasco, Woods, Marks, Cheok, & Spence, 2016). For example, Ngo, Misra, and Spence (2011) asked people to match shapes with chocolates varying in cocoa content (30, 70 or 90%) and found that they associated flavours that are more bitter with more angular shapes, whereas Ngo et al. (2013) demonstrated that people consistently match juices rated as sweet with rounder shapes and juices that are considered sour with angular shapes. Other researchers have documented similar crossmodal correspondences with more complex flavours such as cheeses. Gal, Wheeler, and Shiv (2007) asked a group of participants to estimate the surface area of a series of geometric shapes before evaluating a group of cheeses, and they found that participants who evaluated the surface area of angular (rather than rounded) shapes perceived the cheese to taste sharper. Going one step further, Spence, Ngo, Percival, and Smith (2013) analysed the shape symbolism of each flavour component of different types of cheese (taste, smell, texture and overall flavour) and showed that crossmodal correspondences were mainly based on the taste rather than the smell or the texture. Associations have been documented even in flavours processed almost entirely by the trigeminal system: two studies that analysed the case of carbonated water showed that still water was consistently matched with rounded shapes while sparkling water was associated with angular shapes (Ngo, Piqueras-Fiszman, & Spence, 2012; Spence & Gallace, 2011). Although recent studies have challenged the idea that the same associations are universally shared and have suggested differences between cultures (Bremner et al., 2013; Wan et al., 2014), on average these effects have proven to be robust and consistent across products and groups of participants (Parise, 2016; Spence, 2011). Since shapes can apparently influence the evaluation of food regardless of whether they are seen before (Gal et al., 2007) or during consumption (Liang et al., 2013), one might expect that the shape of an image shown on a package could influence consumer's spiciness expectations (Velasco et al., 2014; Velasco, Woods, Petit, et al., 2016). Accordingly, we propose:

H1a. Spiciness will be associated with angular rather than with rounded shapes.

H1b. A product will be more easily associated with spiciness if the image depicted on its package has an angular rather than a rounded shape.

2.3. Angularity as a cue for aggressiveness

The crossmodal matching between shapes and flavours may be explained by an affective mechanism, as people's liking for a stimuli appear to influence their shape matching responses (for flavour-shape affective correspondences, see Liang et al., 2013; Velasco et al., 2015; for odour-shape affective correspondences see also Hanson-Vaux, Crisinel, & Spence, 2013; Seo et al., 2010). Given that some researchers have proposed that the associations between stimuli from different senses are mediated by emotion (Guerdoux, Trouillet, & Brouillet, 2014; Palmer, Schloss, Xu, & Prado-Leon, 2013; Schifferstein & Tanudjaja, 2004), it has been suggested that sweet-rounded correspondences and bitter/sour-angular correspondences may share an affective congruence in which sweet tastes and rounded shapes are regarded as pleasant stimuli whereas bitter/sour tastes and angular shapes are initially considered unpleasant stimuli (Bar & Neta, 2006; Steiner, 1974). In fact, a large number of studies support the idea that while organic and rounded shapes are considered pleasant and friendly, pointy shapes elicit threat and aggressiveness and are therefore more commonly disliked (Bar & Neta, 2006; Carbon, 2010; Dazkir & Read, 2012; Ghoshal, Boatwright, & Malika, 2015; Larson, Aronoff, & Stearns, 2007; Leder & Carbon, 2005; Westerman et al., 2012). Two classical studies in this field showed that there is an association between the aggressiveness of a concept and the angularity of the line chosen to represent it, as in both cases words like "hard", "cruel" or "furious" were matched with angled lines more frequently than concepts like "merry", "weak" or "gentle", which were consistently paired with rounded lines (Lundholm, 1921; Poffenberger & Barrows, 1924). In a more recent study, Bar and Neta (2006) suggested that objects with angled contours trigger a greater sense of threat than objects with rounded contours, and demonstrate that the contour of an object has a critical role in people's attitude towards it since stimuli with rounded shapes were preferred to stimuli with angular shapes. The relation between shapes and aggressiveness has been documented even in studies of human facial expression, which suggest that diagonal and angular face patterns convey threat whereas round face patterns evoke warmth (Aronoff, Woike, & Hyman, 1992). This association is implicit and automatic not only at the cognitive level (Larson, Aronoff, & Steuer, 2012) but also at the physiological level, since a fMRI test shows that an angular stimulus causes more activity in the amygdala than a rounded stimulus (Bar & Neta, 2007).

Given the above, it has been argued that a reason by which angular shapes and bitter tastes are commonly associated is because both stimuli evoke threat (Turoman, Velasco, Chen, Huang, & Spence, 2018), as many natural poisons have a bitter taste (Garcia & Hankins, 1975; Lundström et al., 2011). We hypothesize that this is also the case for spiciness, and we propose that spiciness and angular shapes share a common cognitive space in which both stimuli are rendered as aggressive. Indeed, some studies link spiciness and aggressiveness (Batra, Ghoshal, & Raghunathan, 2017). The irritation produced by capsaicin leads to the characteristic burning sensation of spicy foods, which has been related with discomfort or even pain (Bègue, Bricout, Boudesseul, Shankland, & Duke, 2015; Byrnes & Hayes, 2013) and in turn may evoke aggressiveness (Berkowitz, 1990, 1993). Therefore:

H2. The effect of shape angularity on spiciness expectations will be mediated by perceived aggressiveness of the shape.

3. Pretests

3.1. Adequacy of the chosen stimulus

A fire icon depicted on the front of a bag of nuts was chosen as the stimulus for this experiment under the assumption that it is a propositionally indeterminate visual sign which may evoke both spicy and roasted meanings to the observer. To verify this assumption, a pretest was conducted in which 31 participants (16 female, mean age 20.7 years) completed an open-ended task. Instructions were given as follows: *"Imagine you are in a supermarket and you see a bag of nuts on which front an icon of fire is depicted. When you see fire depicted on a nuts bag, you think it means the nuts are…"*. The participants were asked to respond as quickly as possible. The elicited meanings were *Spicy* (in Spanish, *Picantes*; N = 18, 58.1%) and *Roasted* (in Spanish, *Tostados*; N = 13, 41.9%). No other words were elicited. The difference between the two percentages was not significant ($\chi^2 = 0.806$, p = 0.37), thus showing that a bag of nuts with a depiction of fire is adequate for this experiment since the fire image can be interpreted in two different ways (i.e. that the nuts are spicy or that the nuts are roasted).

3.2. Effectiveness of the icons shape manipulation

Once the adequacy of the stimulus had been checked, a total of eight fire icons varying only in their shape were designed of which four were intended to be considered angular (A, B, C and D) and the other four were intended to be rather perceived as rounded (E, F, G and H), see Fig. 1a. The stimuli were designed with Adobe Illustrator CC 2017.1.0 (Adobe Systems Incorporated, 2006). Since the shape of the image

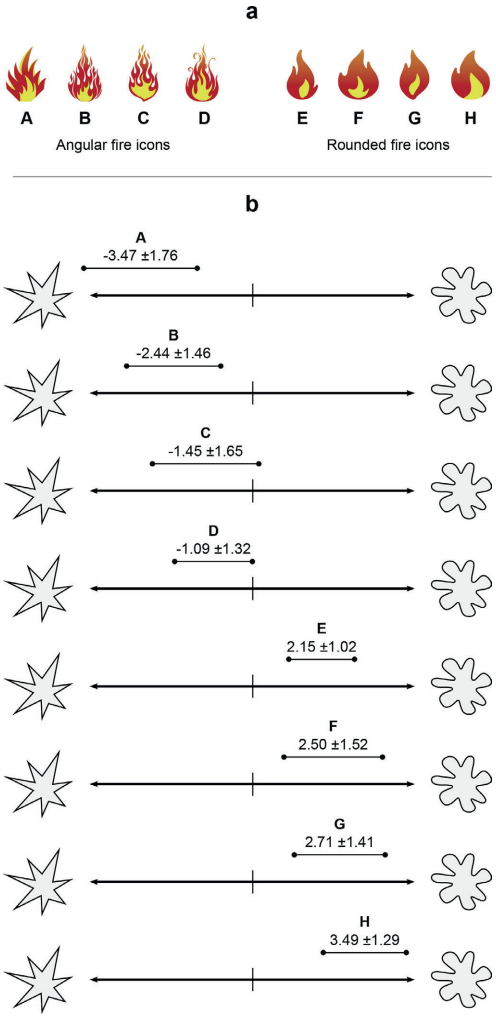

Fig. 1. (a) The eight fire icons designed as the stimuli for the experiment; (b) the eight scales used to measure the effectiveness of the icons shape manipulation. Each scale was 10 cm long. The vertical lines represent the mid-points of the scales. The participants' mean response ± the standard deviation (SD) is represented above each scale.

depicted on the packaging is the independent variable of this experiment, the effectiveness of the shape manipulation was verified by conducting a pretest in which 35 participants (20 female, mean age 23 years) evaluated the angularity of each of the eight fire icons. Adapting the design of Spence & Gallace (2011), participants were given a sheet of paper with eight scales (four randomly distributed on each side of the sheet) on which to place each of the fire icons (the scales can be seen in Fig. 1b). The shapes depicted on each side of the scale are the ones commonly used in this kind of experiments, representing an angular and a rounded shape on each end (Spence & Gallace, 2011). Written instructions were provided as follows: *"Please indicate where each of this icons would be for you on this scale. If you associate the icon more with the shape on the left, make a mark in the left part of the scale. If you associate it more with the shape on the right, make a mark in the right part of the scale. Draw the mark closer to a shape the clearer you see the association with it."* The scale was 10 cm long and had a vertical line marking the mid-point of the line. Responses were measured using a ruler, assigning a value of zero to the mid-point of the scale. Responses on the left half of the scale were registered as negative values and responses on the right half as positive values. A one sample *t*-test was conducted with zero (the mid-point of the scale) as the test value. Results show that each of the four fire icons designed to seem angular rather than rounded were indeed more associated with the angular shape than with the rounded shape (A: $\overline{X} = -3.47$, $t(65) = -11.64$, $p < 0.001$; B: $\overline{X} = -2.44$, $t(65) = -9.85$, $p < 0.001$; C: $\overline{X} = -1.45$, $t(65) = -5.20$, $p < 0.001$; D: $\overline{X} = -1.09$, $t(65) = -4.86$, $p < 0.001$) and that each of the four icons which shape was intended to be considered more rounded than angular were more associated with the rounded rather than the angular end of the scale (E: $\overline{X} = 2.15$, $t(65) = 12.42$, $p < 0.001$; F: $\overline{X} = 2.50$, $t(65) = 9.72$, $p < 0.001$; G: $\overline{X} = 2.71$, $t(65) = 11.32$, $p < 0.001$; H: $\overline{X} = 3.49$, $t(65) = 16.00$, $p < 0.001$; see Fig. 1b).

Additionally, a Ward's hierarchical cluster analysis using squared Euclidean distances as proximity measures revealed that the four fire icons rated as angular made up a single angular icon cluster and that the four icons rated as rounded formed a unique rounded icon cluster (Table 1; see also Dendrogram in Fig. 2). According to this results, the four angular fire icons were henceforth analysed as a single 'angular' fire icons set and the four rounded fire icons as a single 'rounded' fire icons set.

Eight bags of nuts varying only in the shape of the fire icon depicted on its front were created with Adobe Photoshop CC 2017.1.1 (Adobe Systems Incorporated, 2006) based on the findings from these pretests (Fig. 3).

4. Materials and methods

4.1. Participants

66 undergraduate students (35 female, mean age 20.7 years, sd = 2.49) from Zaragoza University took part in this experiment in exchange for being included in a raffle for gift vouchers in a well-known online store. All the participants performed the experiment voluntarily and did not know the real objectives of the study.

4.2. Apparatus and materials

The experiment took place in a quiet room with stable and homogeneous conditions of light and temperature in the Escuela de Ingeniería y Arquitectura of Zaragoza University. Upon arrival, each participant was seated in a single cubicle about 50 cm in front of a 17″ CRT monitor with a resolution of 1366 × 768px and a refresh rate of 60 Hz, and performed the experiment following the instructions shown

Table 1
Ward's hierarchical cluster analysis.

Stage	Cluster combined		Coefficients	Stage cluster first appears		Next stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	G	H	31,585	0	0	4
2	E	F	74,675	0	0	4
3	B	C	126,690	0	0	5
4	E	G	192,418	2	1	7
5	B	D	263,756	3	0	6
6	A	B	443,602	0	5	7
7	A	E	2218,866	6	4	0

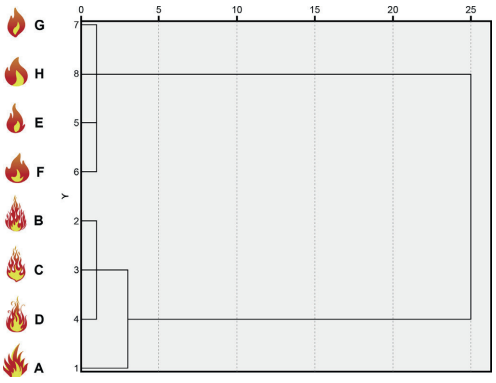

Fig. 2. Dendrogram obtained by means of Ward's hierarchical cluster analysis.

Fig. 3. Example of an angular fire icon (left) and a rounded fire icon (right) bag of nuts designed for the experiment.

on the screen. The software used was OpenSesame 3.1.9 (Mathôt, Schreij & Theeuwes, 2012).

4.3. Design and procedure

The experiment was conducted following a within-subject design that was divided in three parts (Fig. 4). Part order was the same for all the participants. In the first part, the participants were asked to indicate their association between spiciness and shape angularity. In the second part, they were asked to rate the perceived aggressiveness of each of the eight fire icons designed as stimuli for the experiment. The fire icons were displayed one at a time on the screen following a random order. Then, the third task consisted on a speeded classification task in which the effect of the shape angularity of the fire icons on sensory expectations was measured. Finally, demographic information was collected and participants were thanked and debriefed. The experiment lasted from 10 to 15 min per participant.

4.4. Measures

4.4.1. Association between spiciness and shape angularity

The association between spiciness and shape angularity was measured by asking the participants to indicate where would they place spiciness on a scale with an angular shape at one end and a rounded shape at the other, following an identical design to that of the pretest described in section '*3.2. Effectiveness of the icons shape manipulation*'. Written instructions were provided as follows: *"Please indicate where spiciness* (in Spanish, *sabor picante*) *would be for you on this scale. If you associate spiciness more with the shape on the left, make a mark in the left part of the scale. If you associate it more with the shape on the right, make a mark in the right part of the scale. Draw the mark closer to a shape the clearer you see the association with it."* The scale was 10 cm long and had a vertical line marking the mid-point of the line. Scale responses were measured using a ruler assigning a value of zero to the mid-point of the scale. Responses on the left half of the scale were registered as negative values and responses on the right half as positive values.

In addition, the participants were asked to indicate where would they place the roasted flavour (in Spanish, *sabor tostado*) on a second identical scale to check (1) if a crossmodal correspondence also exists between roasted flavour and shape angularity and (2) if so, to verify that it is not as strong as the one between shape angularity and spiciness. In this regard, the participants also performed a matching task in which they indicated which of the shapes displayed in the scale (the angular one or the rounded one) would they associate with spiciness and which one would they associate with the roasted flavour. The purpose of this task was to check if, when forced to decide, the participants would match the angular shape with spiciness and, consequently, the rounded shape with the roasted flavour.

4.4.2. Perceived aggressiveness of the fire icons

The perceived aggressiveness of each of the fire icons was measured according to a Likert scale of 1 (not aggressive at all) to 7 (strongly aggressive). In order to avoid priming (Johnston & Dark, 1986), participants also had to rate each icon according to three other concepts used as distractors.

4.4.3. Effect of the shape angularity of the fire icons on sensory expectations

The effect of the shape of the fire icons on consumer sensory expectations was implicitly measured by means of a speeded classification task. During this, following a design similar to that of the *taste response task* reported by Velasco, Woods, Marks, et al. (2016), the congruence between icon shape and sensory expectations was manipulated and the participants had to categorise the eight bags of nuts used as stimuli as being spicy or roasted. Following our hypothesis, the congruent pairings were angular icons with spiciness and rounded icons with roasted flavour, while the incongruent pairings were rounded icons with spiciness and angular icons with roasted flavour. From now on, these pairings will be referred to as *Angular/Spicy*, *Rounded/Roasted*,

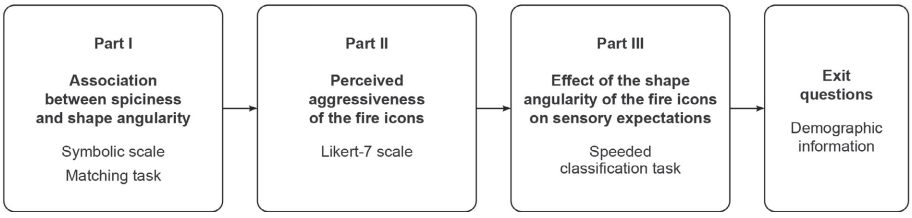

Fig. 4. Outline of the main study.

Table 2
Summary of the blocks of the speeded classification task.

Block	Congruence	Left response key	Right response key	Number of trials
1	Congruent pairings	Angular/Spicy	Rounded/ Roasted	16
2	Reversed congruent pairings	Rounded/ Roasted	Angular/Spicy	16
3	Incongruent pairings	Angular/ Roasted	Rounded/Spicy	16
4	Reversed incongruent pairings	Rounded/ Spicy	Angular/ Roasted	16

Rounded/Spicy and *Angular/Roasted*, respectively.

At the beginning of each block, a screen with instructions was displayed indicating how the stimuli should be classified in the upcoming trials. Throughout each block, the target stimuli appeared (one at a time) in the centre of the screen and the words *Spicy* and *Roasted* remained visible to the left or right of the target stimulus. The participants had to respond as fast and accurately as possible by pressing the E or the I keys on the keyboard according to the correct mapping indicated in the block's instructions. If participants made an error, feedback of a red cross on the screen was shown during 500 ms. The right-left position of *Spicy* and R*oasted* words was counterbalanced between blocks, thus generating four randomly ordered different blocks of trials. Each block consisted of 16 randomly ordered trials (with each stimulus repeated twice), giving rise to a total of 64 trials completed by each participant (Table 2). Block order was randomised across participants. The task was preceded by a set of 16 practice trials which were not analysed in order to familiarize participants with the procedure. The reaction times (RTs) of participants' responses were collected.

The implicit sensory associations for each set of fire icons (angular or rounded) was operationalized as Cohen's d_z standardized difference scores (Cohen, 1988, p. 48; cf. Lakens, 2013). Thus, Cohen's d_z score was calculated for the angular set of icons as the mean of the differences between the RTs of the *Angular/Spicy* and the *Angular/Roasted* trials divided by the standard deviation of those differences, while for the rounded set of icons it was calculated as the mean of the differences between the RTs of the *Rounded/Spicy* and the *Rounded/Roasted* trials divided by the standard deviation of those differences. By doing so, the lower the negative value, or the larger the positive value, the stronger the association with spiciness or roasted flavour, respectively. Note that these Cohen's d_z scores represent a measure of implicit expectations as they were calculated by using the RTs obtained in the speeded classification task, and that the participants were not explicitly asked about their sensory expectations.

4.5. Data analyses

Regarding the association between spiciness and shape angularity, a one sample *t*-test was conducted for each scale (spiciness and roasted flavour) with zero (the mid-point of the scale) as the test value in order to assess if there was a statistically significant association to one of the shapes of the scale. Additionally, a paired measures *t*-test was used to compare the position of each stimulus on the scale in order to verify that both were sufficiently different from each other. A chi-square in contingency tables was used to analyse the results of the matching task.

As for the speeded classification task, the RTs of the incorrect trials (i.e. wrong answers, 6.46% of the responses) or which deviated by more than 3 standard deviations from the participants' conditional mean (2.43% of the correct answers) were excluded from the analyses (Semin & Palma, 2014). Remaining data were first analysed in a 2 × 2 repeated measures ANOVA with the shape of the fire icons (angular, rounded) and expectations (spicy, roasted) as the two factors and the mean reaction time (RT) required to classify each nuts bag as the dependent variable. The aim of this preliminary analysis was to check if an interaction existed so that the mean RTs of each of the four combinations of trials (i.e. *Angular/Spicy*, *Rounded/Roasted*, *Rounded/Spicy* and *Angular/Roasted*) could be analysed separately. Once that condition was fulfilled and the Cohen's d_z scores had been calculated for both the angular and the rounded set of icons, a paired measures *t*-test was used to compare them in order to assess if sensory expectations were influenced by the fire icons shapes.

Finally, a mediation analysis was conducted to investigate whether the effect of the icons' shape on sensory expectations was mediated by the perceived aggressiveness of the icons. Mediation analysis is a regression-based statistical method used to evaluate if an independent variable influences a dependent variable through one or more other intervening variables (Hayes, 2009, 2018). In its simplest form, a simple mediation model is a causal system in which an independent variable X is proposed to influence a dependent variable Y through a single mediating variable M, thus allowing to assess the mechanism by which X exerts its effect on Y (Hayes, 2018). According to our proposed model, an angular fire icon is considered more aggressive than a rounded fire icon, which in turn raises spiciness (vs roasted flavour) expectations (being the opposite true for a rounded fire icon). Hence, the shape of the fire icons (angular or rounded) was used as the two-condition independent variable, the Cohen's d_z score was used as the dependent variable, and the mean perceived aggressiveness of each fire icon set was used as the mediating variable. The analysis was carried out using the MEMORE 1.1 macro for SPSS according to the method proposed for within-subject experimental designs by Montoya and Hayes (2017). MEMORE is a macro for SPSS which allows to easily implement the method described by Judd, Kenny, and McClelland (2001) by which mediation analysis should be conducted in within-subject designs. Bias-corrected bootstrapping (5000 samples) was used to calculate confidence intervals for the indirect effect.

Effects for the t-tests and the ANOVA were considered statistically significant when $p < 0.05$. The indirect effect of the mediation analysis was considered significant if it did not include zero (Montoya & Hayes, 2017). Effect sizes for paired measures t tests were operationalized as Cohen's d_z standardized difference scores (Cohen, 1988, p. 48). The data was processed and analysed by using SPSS Statistics 23 (Armonk, NY, USA).

5. Results

5.1. Association between spiciness and shape angularity

An association exists between spiciness and angularity, as the participants judged spiciness as having a significantly pointy shape, $\overline{X} = -3.75$ cm, $t(65) = -37.16$, $p < 0.001$, supporting H1a. In contrast, roasted flavour was not found to be associated neither with the angular shape nor with the rounded shape, $\overline{X} = 0.09$ cm, $t(65) = 0.37$, $p = 0.71$. Thus, both stimulus were located on the scale in places significantly different from each other, $t(65) = 15.32$, $p < 0.001$, $d_z = 1.89$ (Fig. 5).

The results of the matching task reinforce these findings and show that the angular shape is robustly matched with spiciness and, as a result, the rounded shape is matched with the roasted flavour (angular/spicy and rounded/roasted matches, respectively: N = 63, 95.4%; $\chi^2 = 54.545$, $p < 0.001$). These findings suggest that while the roasted flavour is not associated with any particular shape when assessed by itself, it is consistently paired with the rounded shape in a matching task due to the strong association that exists between spiciness and angular shapes.

5.2. Effect of the shape angularity of the fire icons on sensory expectations

The results of the 2x2 repeated measures ANOVA show that the interaction between the shape of the fire icons and sensory expectations

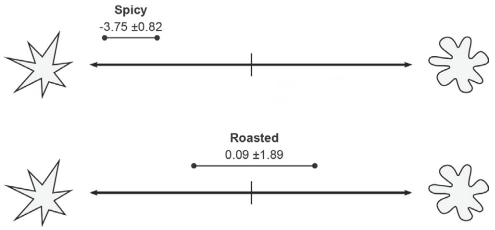

Fig. 5. Results of the association between spiciness/roasted flavour and shape angularity. Each scale was 10 cm long. The vertical lines represent the mid-point of the scales. The participants' mean response ± the standard deviation (SD) for each stimulus are represented above the scales.

Table 3
Mean RTs obtained in the speeded classification task.

Fire icons shape	Mean RTs in ms (SD)		Cohen's d_z
	Spicy	Roasted	
Angular	512 (79)	574 (127)	−0.57
Rounded	567 (147)	507 (74)	0.42

was significant, $F(1,65) = 27.44$, $p < 0.001$, $\eta_p^2 = 0.30$, so the four combinations of trials (i.e. *Angular/Spicy*, *Rounded/Roasted*, *Rounded/Spicy* and *Angular/Roasted*) were analysed separately. As can be seen in Table 3, participants classified the angular fire icons significantly faster when they were associated with spiciness than when they were associated with the roasted flavour, $t(65) = 4.84$, $p < 0.001$, $d_z = 0.59$. Furthermore, participants classified the rounded fire icons significantly faster when they were associated with the roasted flavour than when they were associated with spiciness, $t(65) = -4.21$, $p < 0.001$, $d_z = -0.52$. No differences were found within the congruent pairing, $t(65) = -0.63$, $p = 0.53$, $d_z = -0.08$, nor within the incongruent pairing, $t(65) = -0.63$, $p = 0.53$, $d_z = -0.08$.

The shape angularity of the fire icons exerted an influence on sensory expectations, as the nuts' bags which displayed angular fire icons were associated with spiciness (Cohen's $d_z = -0.57$), and the nuts' bags with rounded fire icons were conversely associated with the roasted flavour (Cohen's $d_z = 0.42$), $t(65) = 4.66$, $p < 0.001$, $d_z = 0.57$, supporting H1b.

5.3. Indirect effect of the shape angularity of the fire icons on sensory expectations through the fire icons' perceived aggressiveness

The results of the mediation analysis show that the fire icons' angularity indirectly influenced sensory expectations through its effect on how aggressive the fire icons' were perceived (Fig. 6), thus supporting H2. The indirect effect of the fire icons' shape on sensory expectations through the icons' perceived aggressiveness was statistically significant, with the 95% not containing zero (Bootstrap [5000] results: $B = -0.91$, $SE = 0.35$, 95% CI [−1.56, −0.19]). The participants considered the angular fire icons as more aggressive than the rounded fire icons ($B = 2.61$, $SE = 0.15$, $p < 0.001$), which in turn increased the expectations that the product was spicy rather than roasted ($B = -0.35$, $SE = 0.17$, $p < 0.05$). The direct effect of the fire icons' shape on sensory expectations was not significant ($B = -0.08$, $SE = 0.50$, $p = 0.88$), suggesting that there was no evidence that the shape of the fire icons had an effect on sensory expectations regardless of its aggressiveness perception (Hayes, 2018).

6. Discussion

This research assessed if the crossmodal correspondence between spiciness and shapes could be used to modulate how people interpret an ambiguous image depicted on food packaging. To that end, the association between spiciness and angular shapes was studied, and a response time-based experiment was conducted on which it was assessed if the spiciness expectations of a bag of nuts could be enhanced by manipulating the angularity of a fire icon depicted on its front. The results indicate that the packages displaying angular fire icons enhanced spiciness expectations, whereas the packages with rounded fire icons were more easily associated with the roasted flavour. This influence was mediated by the perceived aggressiveness of the icons, so that a pointy fire icon raised spiciness expectations through a higher aggressiveness perception.

This investigation can be framed in the literature related to the influence of visual extrinsic cues on consumer expectations and response to food, where the effect of factors such as packaging shape (Becker et al., 2011; Overbeeke & Peters, 1991; Rebollar, Lidón, Serrano, Martín, & Fernández, 2012; Smets & Overbeeke, 1995), packaging colours (Piqueras-Fiszman & Spence, 2011; Spence, 2018; Tijssen, Zandstra, de Graaf, & Jager, 2017) or packaging images (Lidón, Rebollar, Gil-Pérez, Martín, & Vicente-Villardón, in press; Rebollar et al., 2016, 2017; Smith et al., 2015; Szocs & Lefebvre, 2016) has been analysed (see Piqueras-Fiszman & Spence, 2015; and Velasco, Woods, Petit, et al., 2016, for reviews). As we will discuss here, the findings of this research contribute to the literature in two ways. First, these results go a step further in the field of crossmodal correspondences by documenting an association between spiciness and pointy shapes and suggesting that it is mediated through affective evaluation. Second, we show that these findings can be implemented in the field of semiotics in order to help packaging designers and producers to convey the right messages to the consumer, as one of the possible interpretations of an image displayed on a packaging may be favoured by manipulating the image's shape.

The results of this study contribute to the research of crossmodal correspondences showing that an association exists between spiciness and pointy shapes. Although this association had never been empirically tested before, there were grounds to think that pointy shapes and

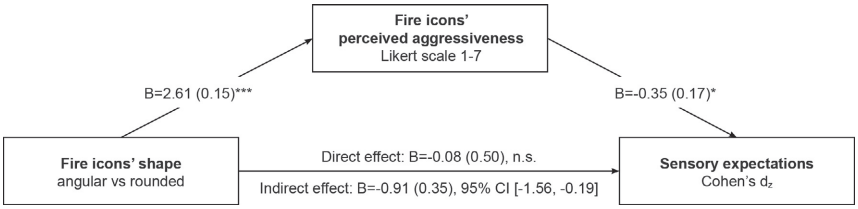

Fig. 6. Mediation of fire icons' perceived aggressiveness between fire icon's shape and sensory expectations (MEMORE 1.1, number of bootstraps = 5000; Montoya & Hayes, 2017). *Note:* Negative values in the dependent variable represent a stronger association with spiciness rather than with roasted flavour, while the opposite is true for positive values. Coding = angular (1), rounded (0); B (SE) = path coefficient (standard error); $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

spiciness may be matched in consumers' mind (Blazhenkova & Kumar, 2018; Wang et al., 2017). Indeed, this result is in line with previous studies that have documented associations between spiciness and cues from other sensory domains such as audition (Wang et al., 2017) or sight (Levitan & Shermer, 2014; Tu et al., 2016). For example, Seo et al. (2010) demonstrated that the smell of pepper (which, according to Wang et al, (2017), is an approximate olfactory counterpart to the trigeminal spicy sensation) is more associated with angular shapes rather than with rounded shapes. Given that olfaction plays a key role in the perception of flavour (Spence et al., 2014; Spence, 2015a, 2015b), it is not surprising that this association also occurs when thinking about other flavour contributors such as the burning sensation caused by capsaicin (Lawless, 1989; Spence, 2015b). In this regard, it may be argued that this association could have been driven based either on trigeminal cues or aromas, as the term *spiciness* may refer to both. Spiciness is a sensation that can contribute to flavour perception (Lawless, 1989; Spence, 2015b). *Spicy* may be sometimes, and for some, equivalent to painful, warm, irritating, burning (Bègue et al., 2015; Caterina et al., 1997). One may think that since in our main study there were two types of shapes and two sensory descriptors, the correspondence could have been driven based either on trigeminal cues or aromas. However, we propose that the correspondence is more trigeminal-based since spiciness was highly associated with the angular shape, but the roasted flavour (when assessed by itself) was not particularly associated to a shape. In addition, the fact that the effect was mediated by aggressiveness supports the notion that the difference is more based on trigeminal associations, since the concept of "roasted aroma" in this food context cannot be painful (nor linked to aggressiveness).

Furthermore, our results indicate that the association between spiciness and pointy shapes is affectively mediated, since perceived aggressiveness of the icons designed to convey sensory information increased spiciness expectations. This supports the notion that crossmodal correspondences between flavours and shapes may be, at least to some extent, explained in terms of affective mediation (Guerdoux et al., 2014; Palmer et al., 2013; Schifferstein & Tanudjaja, 2004), and is in line with previous findings that suggest that both pointy shapes and spiciness share a common affective space in which both stimuli are rendered as unpleasant or aggressive: while pointy shapes are generally associated with dangerous objects (Ghoshal et al., 2015) or even angry faces (Aronoff et al., 1992) and therefore are initially disliked in comparison with rounded shapes (Bar & Neta, 2006), the burning trigeminal sensation produced by the capsaicin of spicy food has been related to discomfort, unpleasantness or pain (Bègue et al., 2015; Byrnes & Hayes, 2013; Caterina et al., 1997). Thus, the results of this research add to those of other studies which suggest that the mechanism behind the crossmodal correspondence between flavour and shapes is of an affective nature and do not fit satisfactorily into any of the three kinds of crossmodal correspondences previously proposed in the literature (i.e. statistical, structural or semantic; Spence, 2011). Indeed, the studies that have assessed separately the association between abstract shapes and each of the sensory components of flavour perception (i.e. taste, smell or trigeminal; Spence et al., 2014) appear to be in the same line, as is the case with taste-shape correspondences (Liang et al., 2013; Velasco et al., 2015), odour-shape correspondences (Hanson-Vaux et al., 2013; Seo et al., 2010) or trigeminal-shape correspondences (Spence et al., 2014): the mechanism behind these correspondences seems to work indirectly through emotion rather than through environmental or language inferences (cf. Turoman et al., 2018). However, note that it seems unlikely that the association between spiciness and pointy shapes is exclusively mediated by an affective evaluation: although the evidence suggesting that affective judgements play an important role in the matching between different stimuli across the senses related to flavour perception is strong, other still unknown mechanisms may also be at play (Turoman et al., 2018). In this regard, both the literature on shapes and motivation (Velasco, Salgado-Montejo, et al., 2016) and the literature on embodiment and grounded cognition (Salgado-Montejo, Tapia Leon, Elliot, Salgado, & Spence, 2015; Te Vaarwerk, van Rompay, & Okken, 2015) may offer alternative explanations for the findings reported here. While the shapes and motivation approach argues that people tend to avoid negatively-valenced stimuli and to approach positively-valenced stimuli (Krieglmeyer, Deutsch, de Houwer, & de Raedt, 2010; although the association between angular shapes and approach/avoidance motivation is yet not completely understood, e.g. Palumbo, Ruta, & Bertamini, 2015; Velasco, Salgado-Montejo, et al., 2016), embodiment assumes that people interpret abstract concepts in terms of everyday physical interactions (Lakoff & Johnson, 1999). As stated by Fenko & van Rompay (2018), embodied cognition commonly assumes that the representation of symbolic concepts is grounded in direct bodily experience with the physical world. For example, abstract concepts like *importance* and *dominance* are processed in terms of physical properties such as *weight* and *height*, as people tend to relate the heaviness of an object and its perceived importance (Jostmann, Lakens, & Schubert, 2009) or the relative height of a product and its perceived dominance (van Rompay, Hekkert, Saakes, & Russo, 2005). Thus, according to this approach the association between spiciness and pointy shapes could also be explained because both concepts are structured under a similar underlying schema (van Rompay, Hekkert, & Muller, 2005): Since early childhood we learn that physical and tactile interactions with angular objects may produce harm or pain on our skin, in the same way as spicy food may produce a similar sensation inside the mouth (Bègue et al., 2015; Caterina et al., 1997). Furthermore, it is worth mentioning that while aggressiveness is commonly related to threat and is thus initially disliked (Berkowitz, 1990; Liu, 2004), that does not necessarily mean that it will be always processed as a negative input (Landwehr, McGill, & Herrmann, 2011). As is the case with other initially disliked stimuli as angular shapes or bitter flavours, in some contexts the concept of aggressiveness may be linked to positive judgements and therefore may be rendered as positive (Ghoshal et al., 2015; Landwehr et al., 2011).

From a semiotic point of view, the main contribution of this paper is that it shows that when it comes to convey sensory information about a product though an image depicted on its packaging, the reported crossmodal correspondence between spiciness and shapes can be used to favour one of the image's possible interpretations. Although this possibility has been somewhat suggested by previous researchers (Ngo et al., 2012; Velasco, Woods, Petit, et al., 2016), this is the first study that specifically addresses it experimentally by manipulating the shape of an image depicted on a package. This finding can be framed on both the two lines of analysis proposed in the literature that seek to understand the factors by which an indeterminate stimulus evokes a particular meaning: the slot/filler approach and the analogy approach (Smith et al., 2015). The slot/filler approach assumes that the probabilities of opting for one of the possible meanings of the sign (filler) will be greater the better it fits with any of the possible attributes of the object (slot) (Fillmore & Baker, 2010; Lynott & Connell, 2010; Smith, Osherson, Rips, & Keane, 1988), while the analogy approach states that the interpretation that has proved valid in similar past combinations will be preferred (Estes & Jones, 2006; Gagné & Spalding, 2006; van Jaarsveld, Coolen, & Schreuder, 1994; see also Gregan-Paxton & John, 1997). The results of this investigation show that the shape of the image plays a role in these mechanisms, as it helps to evoke meaning by making a certain association more accessible in the mind of the consumer. Thus, according to the slot/filler approach, the results of this experiment can be explained as that an angular fire icon is associated with spiciness through an affective mechanism, so the concept *spicy* becomes more accessible to the consumer and therefore the chances of choosing it are increased. In addition, the existence of a crossmodal correspondence between spiciness and angular shapes implies that these results can also be explained under the analogy approach, since both spicy and pointy stimulus are consistently paired in consumers' mind as a congruent match. Overall, these findings show that when it comes to convey spiciness information about a product, images' shape

angularity may be used besides other well-known signs such as textual claims or graphical scales (like the chillies scales commonly used in food packaging, where the higher the number of chillies shown, the spicier the food is supposed to be). Indeed, given the influence of sign congruency on consumer attitude (Becker et al., 2011), designers should be careful to ensure that all signs on the packaging send a consistent message.

However, as is the case in other works related to the study of crossmodal correspondences, the question arises as to what extent it is an association produced automatically in the mind of the consumer or, on the contrary, it rather emanates from a strategic process (Spence & Deroy, 2013). Some authors warn of the need to quantify the degree of automatism of the correspondences instead of adopting a two-pronged approach between bottom-up and top-down processes (Getz & Kubovy, 2018), and highlight the lack of consensus regarding what characteristics a process should have in order to be considered automatic (Spence & Deroy, 2013). Although conducting a speeded classification task allows to minimize the degree of reasoned processing (De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009), it is important to be cautious when drawing conclusions about the true nature of this correspondence since it has been shown that a lot of processes occur in the milliseconds in which the participant takes time to respond (Fiebelkorn, Foxe, & Molholm, 2010; Horowitz, Wolfe, Alvarez, Cohen, & Kuzmova, 2009; Spence & Deroy, 2013) and recent research has suggested that crossmodal correspondences may not be absolute in nature and may rather be subjected to the specific configuration of the task (Brunetti, Indraccolo, Gatto, & Spence, 2017).

Beyond its contributions, this study has some limitations that must be taken into account. For example, there may be a bias regarding the diversity and features of the participants. Sample size was modest and all participants were university students living in the same country (Spain); as a result, further testing would be needed to see if these results could be extrapolated to other markets and other cohorts of consumers. In this regard, note that although some studies have found differences among populations (Bremner et al., 2013), crossmodal correspondences are shared by a large number of people (Spence, 2011). Indeed, few studies have been conducted to date studying individual differences (Parise, 2016). However, one may wonder if the semantic interpretation of the symbols displayed on product packaging would be different regarding consumer's culture and language, given that some studies suggest that structural differences between languages based on ideographic writing systems (e.g. Chinese) and western languages may influence packaging perception (Hoon Ang, 1997; Schmitt, Pan, & Tavassoli, 1994). A similar question arises regarding not only how people interpret symbols according to the structure of their language, but also according to their culture. Whereas for the participants in this study the depiction of an icon of fire in the context of food elicited the meaning of spiciness, this may not be the case across different cultures or consumer cohorts. Although the metaphor *spicy food is fire* relays on a sensation emerging directly from the sensory domain (Caterina et al., 1997; Tu et al., 2016), and may therefore be considered more stable across cultures than other kind of metaphors (e.g. linguistic metaphors, Landau, Meier, & Keefer, 2010), previous studies have suggested that the existence of individual differences should not be disregarded even within the same cultural group (Piqueras-fiszman, Ares, & Varela, 2011).

Moreover, although in this type of study it is very difficult to completely isolate the study variable and there is a risk that part of the effects reported here are not exclusively due to the angularity of the icons but to another factor, the icons were designed as similar as possible in terms of size, symmetry and colour (Parise, 2016). Despite this, it could be argued that they are not only differentiated by angularity but also by other factors such as complexity, symmetry or colour, which in turn could have influenced the results (Turoman et al., 2018). Therefore, it cannot be ruled out that other factors besides angularity may have had an effect on the findings reported in this study, which leaves the door open to further research. On the other hand, despite the fact that participants did not know the true aim of the study, it should be noted that the order of the different experiment parts may have primed the responses for the subsequent tasks by making some concepts (namely, aggressiveness) more accessible in participants' minds. Priming is said to occur when one stimulus affects how a subsequent stimulus is processed (Johnston & Dark, 1986), so asking the participants to rate the perceived aggressiveness of each of the fire icons used as stimuli in the speeded classification task may have biased their responses. To prevent this, the participants had also to evaluate each fire icon with respect to three other concepts not related to the objectives of the study (which were used as distractors). However, despite this precaution, the presence of a priming effect cannot be completely ruled out. Furthermore, the crossmodal association between spiciness and angular shapes was studied by using the spicy word and not by tasting spicy samples of food. Further research is thus needed in order to assess if this correspondence also occurs with tastants and not only with words (Velasco, Woods, Marks, et al., 2016).

The work presented in this paper can be further developed through future lines of research. For example, this study did not analyse the effect of the fire icons shape on consumer affective response. It would be reasonable to expect that a higher perceived aggressiveness would lead to a positive attitude towards the product for consumers who like spicy food, while the opposite would be expected for people who does not like the burning sensation produced by pungent food. It would also be interesting to assess how the findings reported here relate to other signs commonly used to indicate the degree of spiciness of a food, such as chillies scales: according to our findings, one might think that the manipulation of the chillies' shape may be used to modulate spiciness expectations conveyed by the scale. In addition, the scope of this research was limited to studying the effect of manipulating the shape of an icon of fire depicted on a package on consumer expectations. The next logical step would be to assess if the shape manipulation also has an effect on sensory perception and on the hedonic response to the product, as other studies in this field suggest (Becker et al., 2011; Velasco et al., 2015). Moreover, it should be taken into account that while in this paper spiciness has been treated as if it was a single stimulus, in reality there are many kinds of spiciness differentiated in their intensity, their duration, and in the location of the trigeminal system receptors that react in contact with capsaicin (Baron & Penfield, 1996; Caterina et al., 1997; Prescott & Stevenson, 1995). Therefore, a next study should consider these differences by analysing their effect on the crossmodal correspondence between spiciness and abstract shapes.

7. Conclusion

For the consumer, correctly interpreting the visual signs depicted on food packaging is key to set the right sensory expectations. However, since an image can evoke different meanings in a given context, it is not easy for the designer to anticipate how the consumer will interpret it. The results of this investigation shed light in this subject showing that designers can communicate sensory information about the product just by manipulating the shape of the images depicted on the packaging. Specifically, it shows that while it is possible to communicate that a bag of nuts is spicy through a pointy fire icon (since the consumer implicitly associates spiciness and pointy shapes because both stimuli are rendered as aggressive), if the same bag of nuts displays a rounded fire icon the consumer rather interprets that the product have been roasted. Overall, these findings suggest that if a designer has to convey that the product contained in a package is spicy, it may be a good idea to do so by depicting angular images or pointy shapes rather than by depicting rounded shapes. This paper thus shows a useful way to implement the theoretical advances made to date regarding the crossmodal correspondence between spiciness and abstract shapes. This is of great interest to producers and food packaging designers as it can help them to better communicate the desired message to consumers.

References

Alter, A. L., & Oppenheimer, D. M. (2009). Uniting the tribes of fluency to form a metacognitive nation. *Personality and Social Psychology Review, 13*(3), 219–235. https://doi.org/10.1177/1088868309341564.

Ares, G., Piqueras-Fiszman, B., Varela, P., Marco, R. M., López, A. M., & Fiszman, S. (2011). Food labels: Do consumers perceive what semiotics want to convey? *Food Quality and Preference, 22*(7), 689–698. https://doi.org/10.1016/j.foodqual.2011.05.006.

Aronoff, J., Woike, B. A., & Hyman, L. M. (1992). Which are the stimuli in facial displays of anger and happiness: Configurational bases of emotion recognition. *Journal of Personality and Social Psychology, 62*(6), 1050. https://doi.org/10.1037/0022-3514.62.6.1050.

Bar, M., & Neta, M. (2006). Humans prefer curved visual objects. *Psychological Science, 17*(2001), 645–648. https://doi.org/10.1111/j.1467-9280.2006.01759.x.

Bar, M., & Neta, M. (2007). Visual elements of subjective preference modulate amygdala activation. *Neuropsychologia, 45*(10), 2191–2200. https://doi.org/10.1016/j.neuropsychologia.2007.03.008.

Barnett-Cowan, M. (2010). An illusion you can sink your teeth into: Haptic cues modulate the perceived freshness and crispness of pretzels. *Perception, 39*(12), 1684–1686. https://doi.org/10.1068/p6784.

Baron, R. F., & Penfield, M. P. (1996). Capsaicin heat intensity – Concentration, carrier, fat level, and serving temperature effects. *Journal of Sensory Studies, 11*(4), 295–316. https://doi.org/10.1111/j.1745-459X.1996.tb00046.x.

Barthes, R. (1977). *Image music text.* New York: Hill and Wang.

Batra, R. K., Ghoshal, T., & Raghunathan, R. (2017). You are what you eat: An empirical investigation of the relationship between spicy food and aggressive cognition. *Journal of Experimental Social Psychology, 71*, 42–48. https://doi.org/10.1016/j.jesp.2017.01.007.

Becker, L., van Rompay, T. J. L., Schifferstein, H. N. J., & Galetzka, M. (2011). Tough package, strong taste: The influence of packaging design on taste impressions and product evaluations. *Food Quality and Preference, 22*(1), 17–23. https://doi.org/10.1016/j.foodqual.2010.06.007.

Bègue, L., Bricout, V., Boudesseul, J., Shankland, R., & Duke, A. A. (2015). Some like it hot: Testosterone predicts laboratory eating behavior of spicy food. *Physiology and Behavior, 139*, 375–377. https://doi.org/10.1016/j.physbeh.2014.11.061.

Berkowitz, L. (1990). On the formation and regulation of anger and aggression: A cognitive-neoassiationistic analysis. *American Psychologist, 45*(4), 494–503.

Berkowitz, L. (1993). Pain and aggression: Some findings and implications. *Motivation and Emotion, 17*(3), 277–293. https://doi.org/10.1007/BF00992223.

Blazhenkova, O., & Kumar, M. M. (2018). Angular versus curved shapes: correspondences and emotional processing. *Perception, 47*(1), 67–89. https://doi.org/10.1177/0301006617731048.

Bremner, A. J., Caparos, S., Davidoff, J., de Fockert, J., Linnell, K. J., & Spence, C. (2013). " Bouba" and " Kiki" in Namibia? A remote culture make similar shape-sound matches, but different shape-taste matches to Westerners. *Cognition, 126*(2), 165–172. https://doi.org/10.1016/j.cognition.2012.09.007.

Brunetti, R., Indraccolo, A., Del Gatto, C., & Spence, C. (2017). Are crossmodal correspondences relative or absolute? Sequential effects on speeded classification. *Attention, Perception, & Psychophysics, 1–8*. https://doi.org/10.3758/s13414-017-1445-z.

Byrnes, N. K., & Hayes, J. E. (2013). Personality factors predict spicy food liking and intake. *Food Quality and Preference, 28*(1), 213–221. https://doi.org/10.1016/j.foodqual.2012.09.008.

Carbon, C. C. (2010). The cycle of preference: Long-term dynamics of aesthetic appreciation. *Acta Psychologica, 134*(2), 233–244. https://doi.org/10.1016/j.actpsy.2010.02.004.

Carstens, E., Iodi Carstens, M., Dessirier, J. M., O'Mahony, M., Simons, C. T., Sudo, M., & Sudo, S. (2002). It hurts so good: Oral irritation by spices and carbonated drinks and the underlying neural mechanisms. *Food Quality and Preference, 13*(7–8), 431–443. https://doi.org/10.1016/S0950-3293(01)00067-2.

Caterina, M., Schumacher, M., Timinaga, M., & Rosen, T. (1997). The capsaicin receptor: A heat-activited ion channel in the pathway. *Nature, 389*(October), 816–824.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed). New York, USA: Psychology Press.

Dazkir, S. S., & Read, M. A. (2012). Furniture forms and their influence on our emotional responses toward interior environments. *Environment and Behavior, 44*(5), 722–734. https://doi.org/10.1177/0013916511402063.

De Houwer, J., Teige-Mocigemba, S., Spruyt, A., & Moors, A. (2009). Implicit measures: A normative analysis and review. *Psychological Bulletin, 135*(3), 347–368. https://doi.org/10.1037/a0014211.

Deliza, R., & MacFie, H. J. H. (1996). The generation of sensory expectation by external cues and its effect on sensory perception and hedonic ratings: A review. *Journal of Sensory Studies, 11*(2), 103–128. https://doi.org/10.1111/j.1745-459X.1996.tb00036.x.

Delwiche, J. (1996). Are there "basic" tastes? *Trends in Food Science and Technology, 7*(12), 411–415. https://doi.org/10.1016/S0924-2244(96)20010-X.

Epley, N., & Gilovich, T. (2006). The anchoring-and-adjustment heuristic why the adjustments are insufficient. *Psychological Science, 17*(4), 311–319.

Estes, Z., & Jones, L. L. (2006). Priming via relational similarity: A copper horse is faster when seen through a glass eye. *Journal of Memory and Language, 55*(1), 89–101. https://doi.org/10.1016/j.jml.2006.01.004.

Fenko, A., & van Rompay, T. J. L. (2018). Consumer-driven product design. In G. Ares, & P. Varela (Eds.). *Methods in consumer research, volume 2: Alternative approaches and special applications* (pp. 427–462). Elsevier.

Fiebelkorn, I. C., Foxe, J. J., & Molholm, S. (2010). Dual mechanisms for the cross-sensory spread of attention: How much do learned associations matter? *Cerebral Cortex, 20*(1), 109–120. https://doi.org/10.1093/cercor/bhp083.

Fillmore, C. J., & Baker, C. (2010). A frames approach to semantic analysis. In B. Heine, & H. Narrog (Eds.). *The oxford handbook of linguistic analysis* (pp. 313–340). Oxford: Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199544004.013.0013.

Frascara, J. (1988). Graphic design: Fine art or social science? *Design Issues, 5*(1), 18. https://doi.org/10.2307/1511556.

Gagné, C. L., & Spalding, T. L. (2006). Using conceptual combination research to better understand novel compound words. Retrieved from *SKASE Journal of Theoretical Linguistics, 3*(2), 9–16. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.163.5240&rep=rep1&type=pdf.

Gal, D., Wheeler, S. C., & Shiv, B. (2007). Cross - Modal Influences on Gustatory Perception. Available at SSRN 1030197. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1030197.

Garcia, J., & Hankins, W. G. (1975). The evolution of bitter and the acquisition of toxiphobia. *Olfaction and Taste. V, Proceedings of the 5th International Symposium* (pp. 39–45). Melbourne, Australia: Academic Press. https://doi.org/10.1016/B978-0-12-209750-8.50014-7.

Getz, L. M., & Kubovy, M. (2018). Questioning the automaticity of audiovisual correspondences. *Cognition, 175*(August 2017), 101–108. https://doi.org/10.1016/j.cognition.2018.02.015.

Ghoshal, T., Boatwright, P., & Malika, M. (2015). Curvature from all angles: An integrative review and implications for product design. In R. Batra, C. Seifert, & D. Brei (Eds.). *The psychology of design: Creating consumer appeal* (pp. 91–105). New York: Routledge.

Gregan-Paxton, J., & John, D. R. (1997). Consumer learning by analogy: A model of internal knowledge transfer. *Journal of Consumer Research, 24*(3).

Guerdoux, E., Trouillet, R., & Brouillet, D. (2014). Olfactory-visual congruence effects stable across ages: yellow is warmer when it is pleasantly lemony. *Attention, Perception, and Psychophysics, 76*(5), 1280–1286. https://doi.org/10.3758/s13414-014-0703-6.

Hanson-Vaux, G., Crisinel, A. S., & Spence, C. (2013). Smelling shapes: Crossmodal correspondences between odors and shapes. *Chemical Senses, 38*(2), 161–166. https://doi.org/10.1093/chemse/bjs087.

Hayes, A. F. (2009). Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Communication Monographs, 76*(4), 408–420. https://doi.org/10.1080/03637750903310360.

Hayes, A. F. (2018). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach* (Second edition). New York, NY: Guilford Press.

Honea, H., & Horsky, S. (2012). The power of plain: Intensifying product experience with neutral aesthetic context. *Marketing Letters, 23*(1), 223–235. https://doi.org/10.1007/s11002-011-9149-y.

Hoon Ang, S. (1997). Chinese consumers' perception of alpha-numeric brand names. *Journal of Consumer Marketing, 14*(3), 220–233. https://doi.org/10.1108/07363769710166800.

Horowitz, T. S., Wolfe, J. M., Alvarez, G. A., Cohen, M. A., & Kuzmova, Y. I. (2009). The speed of free will. *Quarterly Journal of Experimental Psychology, 62*(11), 2262–2288. https://doi.org/10.1080/17470210902732155.

Johnston, W. A., & Dark, V. J. (1986). Selective Attention. *Annual Review of Psychology, 37*(1), 43–75. https://doi.org/10.1146/annurev.ps.37.020186.000355.

Jostmann, N. B., Lakens, D., & Schubert, T. W. (2009). Weight as an emodiment of importance. *Psychological Science, 20*(9), 1169–1174.

Judd, C. M., Kenny, D. A., & McClelland, G. H. (2001). Estimating and testing mediation and moderation in within-subject designs. *Psychological Methods, 6*(2), 115–134. https://doi.org/10.1037//1082-989X.6.2.115.

Kauppinen-Räisänen, H., & Luomala, H. T. (2010). Exploring consumers' product-specific colour meanings. *Qualitative Market Research: An International Journal, 13*(3), 287–308. https://doi.org/10.1108/13522751011053644.

Krieglmeyer, R., Deutsch, R., de Houwer, J., & de Raedt, R. (2010). Being moved: Valence activates approach-avoidance behavior independently of evaluation and approach-avoidance intentions. *Psychological Science, 21*(4), 607–613. https://doi.org/10.1177/0956797610365131.

Lähteenmäki, L. (2013). Claiming health in food products. *Food Quality and Preference, 27*(2), 196–201. https://doi.org/10.1016/j.foodqual.2012.03.006.

Laing, S., & Masoodian, M. (2016). A study of the influence of visual imagery on graphic design ideation. *Design Studies, 45*, 187–209. https://doi.org/10.1016/j.destud.2016.04.002.

Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: A practical primer for t-tests and ANOVAs. *Frontiers in Psychology, 4*(NOV), 1–12. https://doi.org/10.3389/fpsyg.2013.00863.

Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh.* New York, NY: Basic Books.

Landau, M. J., Meier, B. P., & Keefer, L. A. (2010). A metaphor-enriched social cognition. *Psychological Bulletin, 136*(6), 1045–1067. https://doi.org/10.1037/a0020970.

Landwehr, J. R., McGill, A. L., & Herrmann, A. (2011). It's got the look: The effect of friendly and aggressive "facial" expressions on product liking and sales. *Journal of Marketing, 75*(3), 132–146. https://doi.org/10.1509/jmkg.75.3.132.

Larson, C. L., Aronoff, J., & Stearns, J. J. (2007). The shape of threat: simple geometric forms evoke rapid and sustained capture of attention. *Emotion, 7*(3), 526–534. https://doi.org/10.1037/1528-3542.7.3.526.

Larson, C. L., Aronoff, J., & Steuer, E. L. (2012). Simple geometric shapes are implicitly associated with affective value. *Motivation and Emotion, 36*(3), 404–413. https://doi.org/10.1007/s11031-011-9249-2.

Lawless, H. T. (1989). Pepper potency and the forgotten flavor sense. *Food Technology,* 52–58 (November).

Leder, H., & Carbon, C. C. (2005). Dimensions in appreciation of car interior design. *Applied Cognitive Psychology, 19*(5), 603–618. https://doi.org/10.1002/acp.1088.
Levitan, C. A., & Shermer, D. Z. (2014). Red hot: The crossmodal effect of color intensity on perceived piquancy. *Multisensory Research, 27*(3–4), 207–223. https://doi.org/10.1163/22134808-00002457.
Lewis, C., & Walker, P. (1989). Typographic influences on reading. *British Journal of Psychology, 80*(2), 241–257. https://doi.org/10.1111/j.2044-8295.1989.tb02317.x.
Liang, P., Roy, S., Chen, M. L., & Zhang, G. H. (2013). Visual influence of shapes and semantic familiarity on human sweet sensitivity. *Behavioural Brain Research, 253*, 42–47. https://doi.org/10.1016/j.bbr.2013.07.001.
Lidón, I., Rebollar, R., Gil-Pérez, I., Martín, J., & Vicente-Villardón, J. L. (in press). The influence the image of the product shown on food packaging labels has on product perception during tasting: effects and gender differences. Packaging Technology and Science. https://doi.org/10.1002/pts.2407.
Liu, J. (2004). Concept analysis: Aggression. *Issues in Mental Health Nursing, 25*(7), 693–714. https://doi.org/10.1080/01612840490486755.
Loken, B. (2006). Consumer psychology: Categorization, inferences, affect, and persuasion. *Annual Review of Psychology, 57*(1), 453–485. https://doi.org/10.1146/annurev.psych.57.102904.190136.
Loken, B., Barsalou, L. W., & Joiner, C. (2008). Categorzation theory and research in consumer psychology: Category representation and category-based inference. *Handbook of Consumer Psychology* (pp. 133–163). .
Lundholm, H. (1921). The affective tone of lines: Experimental researches. *Psychological Review, 28*(1), 43–60. https://doi.org/10.1037/h0072647.
Lundström, J. N., Boesveldt, S., & Albrecht, J. (2011). Central processing of the chemical senses: An overview. *ACS Chemical Neuroscience, 2*(1), 5–16. https://doi.org/10.1021/cn1000843.
Lynott, D., & Connell, L. (2010). Embodied conceptual combination. *Frontiers in Psychology, 1*(NOV), 1–14. https://doi.org/10.3389/fpsyg.2010.00212.
Madzharov, A. V., & Block, L. G. (2010). Effects of product unit image on consumption of snack foods. *Journal of Consumer Psychology, 20*(4), 398–409. https://doi.org/10.1016/j.jcps.2010.06.007.
Mathôt, S., Schreij, D., & Theeuwes, J. (2012). OpenSesame: An open-source, graphical experiment builder for the social sciences. *Behavior Research Methods, 44*(2), 314–324. https://doi.org/10.3758/s13428-011-0168-7.
Messaris, P. (1994). *Visual literacy: Image, mind, and reality.* Boulder: Westview Press.
Messaris, P. (1997). *Visual persuasion: The role of images in advertising.* Thousand Oaks, CA: Sage Publications.
Montoya, A. K., & Hayes, A. F. (2017). Two-condition within-participant statistical mediation analysis: A path-analytic framework. *Psychological Methods, 22*(1), 6–27. https://doi.org/10.1037/met0000086.
Mueller, S., Lockshin, L., & Louviere, J. J. (2009). What you see may not be what you get: Asking consumers what matters may not reflect what they choose. *Marketing Letters, 21*(4), 335–350. https://doi.org/10.1007/s11002-009-9098-x.
Nancarrow, C., Wright, L. T., & Brace, I. (1998). Gaining competitive advantage from packaging and labelling in marketing communications. *British Food Journal, 100*(2), 110–118. https://doi.org/10.1108/00070709810204101.
Ngo, M. K., Misra, R., & Spence, C. (2011). Assessing the shapes and speech sounds that people associate with chocolate samples varying in cocoa content. *Food Quality and Preference, 22*(6), 567–572. https://doi.org/10.1016/j.foodqual.2011.03.009.
Ngo, M. K., Piqueras-Fiszman, B., & Spence, C. (2012). On the colour and shape of still and sparkling water: Insights from online and laboratory-based testing. *Food Quality and Preference, 24*(2), 260–268. https://doi.org/10.1016/j.foodqual.2011.11.004.
Ngo, M. K., Velasco, C., Salgado, A., Boehm, E., O'Neill, D., & Spence, C. (2013). Assessing crossmodal correspondences in exotic fruit juices: The case of shape and sound symbolism. *Food Quality and Preference, 28*(1), 361–369. https://doi.org/10.1016/j.foodqual.2012.10.004.
Overbeeke, C. J., & Peters, M. E. (1991). The taste of desserts' packages. *Perceptual and Motor Skills, 73*(2), 575–580. https://doi.org/10.2466/pms.1991.73.2.575.
Palmer, S. E., Schloss, K. B., Xu, Z., & Prado-Leon, L. R. (2013). Music-color associations are mediated by emotion. *Proceedings of the National Academy of Sciences, 110*(22), 8836–8841. https://doi.org/10.1073/pnas.1212562110.
Palumbo, L., Ruta, N., & Bertamini, M. (2015). Comparing angular and curved shapes in terms of implicit associations and approach/avoidance responses. *PLoS ONE, 10*(10), 1–16. https://doi.org/10.1371/journal.pone.0140043.
Parise, C., & Spence, C. (2013). Audiovisual cross - modal corresp ondences in the general p opul ation. *The Oxfod Handbook of Synesthesia,* 790–815.
Parise, C. V. (2016). Crossmodal correspondences: Standing issues and experimental guidelines. *Multisensory Research, 29*(1–3), 7–28. https://doi.org/10.1163/22134808-00002502.
Peirce, C. S. (1991). In J. Hoopes (Ed.). *Peirce on Signs: Writings on Semiotic.* Chapel Hill: University of North Carolina Press.
Phillips, B. J. (2000). The impact of verbal anchoring on consumer response to image ads. *Journal of Advertising, 29*(1), 15–24. https://doi.org/10.1080/00913367.2000.10673600.
Piqueras-fiszman, B., Ares, G., & Varela, P. (2011). Semiotics and perception: Do labels convey the same messages to older and younger consumers? *Journal of Sensory Studies, 26*(3), 197–208. https://doi.org/10.1111/j.1745-459X.2011.00336.x.
Piqueras-Fiszman, B., Harrar, V., Alcaide, J., & Spence, C. (2011). Does the weight of the dish influence our perception of food? *Food Quality and Preference, 22*(8), 753–756. https://doi.org/10.1016/j.foodqual.2011.05.009.
Piqueras-Fiszman, B., & Spence, C. (2011). Crossmodal correspondences in product packaging. Assessing color-flavor correspondences for potato chips (crisps). *Appetite, 57*(3), 753–757. https://doi.org/10.1016/j.appet.2011.07.012.
Piqueras-Fiszman, B., & Spence, C. (2015). Sensory expectations based on product-extrinsic food cues: An interdisciplinary review of the empirical evidence and theoretical accounts. *Food Quality and Preference, 40*(PA), 165–179. https://doi.org/10.1016/j.foodqual.2014.09.013.
Piqueras-Fiszman, B., Velasco, C., & Spence, C. (2012). Exploring implicit and explicit crossmodal colour-flavour correspondences in product packaging. *Food Quality and Preference, 25*(2), 148–155. https://doi.org/10.1016/j.foodqual.2012.02.010.
Poffenberger, A. T., & Barrows, B. E. (1924). The feeling value of lines. *Journal of Applied Psychology, 8*, 187–205.
Prescott, J., & Stevenson, R. J. (1995). Pungency in food perception and preference. *Food Reviews International, 11*(4), 665–698. https://doi.org/10.1080/87559129509541064.
Rebollar, R., Gil, I., Lidón, I., Martín, J., Fernández, M. J., & Rivera, S. (2017). How material, visual and verbal cues on packaging influence consumer expectations and willingness to buy: The case of crisps (potato chips) in Spain. *Food Research International, 99*, 239–246. https://doi.org/10.1016/j.foodres.2017.05.024.
Rebollar, R., Lidón, I., Gil, I., Martín, J., Fernández, M. J., & Riveres, C. E. (2016). The influence the serving suggestion displayed on soft cheese packaging has on consumer expectations and willingness to buy. *Food Quality and Preference, 52*, 188–194. https://doi.org/10.1016/j.foodqual.2016.04.015.
Rebollar, R., Lidón, I., Serrano, A., Martín, J., & Fernández, M. J. (2012). Influence of chewing gum packaging design on consumer expectation and willingness to buy. An analysis of functional, sensory and experience attributes. *Food Quality and Preference, 24*, 162–170. https://doi.org/10.1016/j.foodqual.2011.10.011.
Reinbach, H. C., Toft, M., & Møller, P. (2009). Relationship between oral burn and temperature in chili spiced pork patties evaluated by time-intensity. *Food Quality and Preference, 20*(1), 42–49. https://doi.org/10.1016/j.foodqual.2008.07.003.
Salgado-Montejo, A., Tapia Leon, I., Elliot, A. J., Salgado, C. J., & Spence, C. (2015). Smiles over frowns: When curved lines influence product preference. *Psychology & Marketing, 32*(7), 771–781. https://doi.org/10.1002/mar.20817.
Schifferstein, H. N. J., & Tanudjaja, I. (2004). Visualising fragrances through colours: The mediating role of emotions. *Perception, 33*(10), 1249–1266. https://doi.org/10.1068/p5132.
Schmitt, B. H., Pan, Y., & Tavassoli, N. T. (1994). Language and consumer memory: The impact of linguistic differences between Chinese and English. *Journal of Consumer Research, 21*(3), 419–431. https://doi.org/10.1086/209408.
Semin, G. R., & Palma, T. A. (2014). Why the bride wears white: Grounding gender with brightness. *Journal of Consumer Psychology, 24*(2), 217–225. https://doi.org/10.1016/j.jcps.2013.09.003.
Seo, H. S., Arshamian, A., Schemmer, K., Scheer, I., Sander, T., Ritter, G., & Hummel, T. (2010). Cross-modal integration between odors and abstract symbols. *Neuroscience Letters, 478*(3), 175–178. https://doi.org/10.1016/j.neulet.2010.05.011.
Silayoi, P., & Speece, M. (2007). The importance of packaging attributes: A conjoint analysis approach. *European Journal of Marketing, 41*(11/12), 1495–1517. https://doi.org/10.1108/03090560710821279.
Smets, G. J. F., & Overbeeke, C. J. (1995). Expressing tastes in packages. *Design Studies, 16*(3), 349–365. https://doi.org/10.1016/0142-694X(94)00003-V.
Smith, E. E., Osherson, D. N., Rips, L. J., & Keane, M. (1988). Combining prototypes: A selective modification model. *Cognitive Science, 12*(4), 485–527. https://doi.org/10.1016/0364-0213(88)90011-0.
Smith, V., Barratt, D., & Selsøe Sørensen, H. (2015). Do natural pictures mean natural tastes? Assessing visual semantics experimentally. *Cognitive Semiotics, 8*(1), 53–86. https://doi.org/10.1515/cogsem-2015-0001.
Spence, C. (2011). Crossmodal correspondences: A tutorial review. *Attention, Perception & Psychophysics, 73*(January), 971–995. https://doi.org/10.3758/s13414-010-0073-7.
Spence, C. (2015a). Eating with our ears: Assessing the importance of the sounds of consumption on our perception and enjoyment of multisensory flavour experiences. *Flavour, 4*(1), 3. https://doi.org/10.1186/2044-7248-4-3.
Spence, C. (2015b). Multisensory flavor perception. *Cell, 161*(1), 24–35. https://doi.org/10.1016/j.cell.2015.03.007.
Spence, C. (2018). Background colour & its impact on food perception & behaviour. *Food Quality and Preference, 68*, 156–166. https://doi.org/10.1016/j.foodqual.2018.02.012.
Spence, C., & Deroy, O. (2013). How automatic are crossmodal correspondences? *Consciousness and Cognition, 22*(1), 245–260. https://doi.org/10.1016/j.concog.2012.12.006.
Spence, C., & Gallace, A. (2011). Tasting shapes and words. *Food Quality and Preference, 22*(3), 290–295. https://doi.org/10.1016/j.foodqual.2010.11.005.
Spence, C., Ngo, M. K., Percival, B., & Smith, B. (2013). Crossmodal correspondences: Assessing shape symbolism for cheese. *Food Quality and Preference, 28*(1), 206–212. https://doi.org/10.1016/j.foodqual.2012.08.002.
Spence, C., & Piqueras-Fiszman, B. (2014). *The perfect meal: The multisensory science of food and dining.* Chichester, UK: John Wiley & Sons Ltd 10.1002/9781118491003.
Spence, C., Smith, B., & Auvray, M. (2014). Confusing tastes with flavours. In D. Stokes, M. Matthen, & S. Biggs (Eds.). *Perception and its modalities* (pp. 247–276). Oxford, UK: Oxford University Press. https://doi.org/10.1093/acprof: oso/9780199832798.003.0011.
Steiner, J. E. (1974). Innate human facial expressions to taste and smell stimulation. *Annals of the New York Academy of Sciences, 237*, 229–233. https://doi.org/10.1111/j.1749-6632.1974.tb49858.x.
Sütterlin, B., & Siegrist, M. (2015). Simply adding the word "fruit" makes sugar healthier: The misleading effect of symbolic information on the perceived healthiness of food. *Appetite, 95*, 252–261. https://doi.org/10.1016/j.appet.2015.07.011.
Szocs, C., & Lefebvre, S. (2016). The blender effect: Physical state of food influences healthiness perceptions and consumption decisions. *Food Quality and Preference, 54*, 152–159. https://doi.org/10.1016/j.foodqual.2016.07.009.
Te Vaarwerk, M. C., van Rompay, T. J. L., & Okken, V. S. (2015). Under cover and close at hand: Embodied metaphor in packaging design. *International Journal of Design, 9*(1),

29–37.
Tijssen, I., Zandstra, E. H., de Graaf, C., & Jager, G. (2017). Why a 'light' product package should not be light blue: Effects of package colour on perceived healthiness and attractiveness of sugar- and fat-reduced products. *Food Quality and Preference, 59*, 46–58. https://doi.org/10.1016/j.foodqual.2017.01.019.
Tu, Y., Yang, Z., & Ma, C. (2016). The taste of plate: How the spiciness of food is affected by the color of the plate used to serve it. *Journal of Sensory Studies, 31*(1), 50–60. https://doi.org/10.1111/joss.12190.
Turoman, N., Velasco, C., Chen, Y. C., Huang, P. C., & Spence, C. (2018). Symmetry and its role in the crossmodal correspondence between shape and taste. *Attention, Perception, and Psychophysics, 80*(3), 738–751. https://doi.org/10.3758/s13414-017-1463-x.
Underwood, R. L., & Klein, N. M. (2002). Packaging as brand communication: Effects of product pictures on consumer responses to the package and brand. Retrieved from *Journal of Marketing Theory and Practice, 10*(4), 58–68. http://search.proquest.com.ezproxy.uned.es/.
van Jaarsveld, H. J., Coolen, R., & Schreuder, R. (1994). The role of analogy in the interpretation of novel compounds. *Journal of Psycholinguistic Research, 23*(2), 111–137. https://doi.org/10.1007/BF02143919.
Van Rompay, T., Hekkert, P., & Muller, W. (2005). The bodily basis of product experience. *Design Studies, 26*(4), 359–377. https://doi.org/10.1016/j.destud.2004.08.001.
van Rompay, T., Hekkert, P., Saakes, D., & Russo, B. (2005). Grounding abstract object characteristics in embodied interactions. *Acta Psychologica, 119*(3), 315–351. https://doi.org/10.1016/j.actpsy.2005.02.001.
Velasco, C., Salgado-Montejo, A., Elliot, A. J., Woods, A. T., Alvarado, J., & Spence, C. (2016). The shapes associated with approach/avoidance words. *Motivation and Emotion, 40*(5), 689–702. https://doi.org/10.1007/s11031-016-9559-5.
Velasco, C., Salgado-Montejo, A., Marmolejo-Ramos, F., & Spence, C. (2014). Predictive packaging design: Tasting shapes, typefaces, names, and sounds. *Food Quality and Preference, 34*, 88–95. https://doi.org/10.1016/j.foodqual.2013.12.005.
Velasco, C., Woods, A. T., Deroy, O., & Spence, C. (2015). Hedonic mediation of the crossmodal correspondence between taste and shape. *Food Quality and Preference, 41*, 151–158. https://doi.org/10.1016/j.foodqual.2014.11.010.
Velasco, C., Woods, A. T., Marks, L. E., Cheok, A. D., & Spence, C. (2016). The semantic basis of taste-shape associations. *Peerj*, 1–20. https://doi.org/10.7287/peerj.preprints.1366v1.
Velasco, C., Woods, A. T., Petit, O., Cheok, A. D., & Spence, C. (2016). Crossmodal correspondences between taste and shape, and their implications for product packaging: A review. *Food Quality and Preference, 52*(4), 17–26. https://doi.org/10.1016/j.foodqual.2016.03.005.
Venter, K., van der Merwe, D., de Beer, H., Kempen, E., & Bosman, M. (2011). Consumers' perceptions of food packaging: An exploratory investigation in Potchefstroom, South Africa. *International Journal of Consumer Studies, 35*(3), 273–281. https://doi.org/10.1111/j.1470-6431.2010.00936.x.
Viana, F. (2011). Chemosensory properties of the trigeminal system. *ACS Chemical Neuroscience, 2*(1), 38–50. https://doi.org/10.1021/cn100102c.
Wan, X., Woods, A. T., Van Den Bosch, J. J. F., McKenzie, K. J., Velasco, C., & Spence, C. (2014). Cross-cultural differences in crossmodal correspondences between basic tastes and visual features. *Frontiers in Psychology, 5*(DEC), 1–13. https://doi.org/10.3389/fpsyg.2014.01365.
Wang, Q., (Janice), Keller, S., & Spence, C. (2017). Sounds spicy: Enhancing the evaluation of piquancy by means of a customised crossmodally congruent soundtrack. *Food Quality and Preference, 58*, 1–9. https://doi.org/10.1016/j.foodqual.2016.12.014.
Westerman, S. J., Gardner, P. H., Sutherland, E. J., White, T., Jordan, K., Watts, D., & Wells, S. (2012). Product Design: Preference for Rounded versus Angular Design Elements. *Psychology and Marketing, 29*(8), 595–605. https://doi.org/10.1002/mar.20546.

4. GENERAL DISCUSSION

4.1. Contributions

Overall, the findings of this thesis are in line with the literature devoted to studying the influence of packaging on consumer perception and response to food, where the effect of visual packaging cues such as colour (Karnal et al., 2016; Mead & Richerson, 2018; Obrist et al., 2014; Piqueras-Fiszman & Spence, 2011; Schuldt, 2013; Tijssen et al., 2017), typefaces (Celhay et al., 2015; Karnal et al., 2016; Velasco et al., 2014; Velasco et al., 2015), material (Labbe et al., 2013; Magnier & Schoormans, 2015, 2017; Magnier et al., 2016; Steenis et al., 2017) or shape (Arboleda & Arce-Lopera, 2015; Festila, 2016; Parise & Spence, 2012; van Ooijen et al., 2017) has been previously documented (see Piqueras-Fiszman & Spence, 2015; and Velasco et al., 2016; for reviews).

Among the studies that have previously addressed the effect of packaging imagery on consumer perception and response, many of them have analysed the effect of displaying (or not) an image (Fenko et al., 2018; Miraballes et al., 2014; Smith et al., 2015; Underwood & Klein, 2002; Versluis et al., 2015) or the effect of manipulating image features such as its size (Neyens et al., 2015; Szocs & Lefebvre, 2017), the number of product units displayed (Madzharov & Block, 2010), its pictorial style (Deliza et al., 2003; Smith et al., 2015) or its location within the package (Deng & Kahn, 2009; Fenko et al., 2018; Kahn & Deng, 2010). However, the specific role of image features such as its subject (i.e. what is displayed and how it is depicted) has been barely examined. The few studies carried out in this regard looked at the effects of manipulating the image congruence (congruent vs incongruent; Mizutani et al., 2010; Sakai & Morikawa, 2006) or the image valence (positive vs negative; Liao et al., 2015; Mizutani et al., 2010). Thus, although these investigations largely contribute to understanding the processes by which consumers perceive food packaging, their applicability in designers' practice is limited since the most common case for packaging is to display a congruent and positive-valenced image (e.g. depicting an appealing picture of the product contained within). Moreover,

research devoted to understanding how consumers interpret packaging imagery has been scarce (for an elaboration on the different approaches adopted in this regard in the fields of semantics and language, see Smith et al., 2015). Yet images are intrinsically ambiguous and can elicit different meanings, so it is key for the designer to anticipate how consumers will interpret packaging images given its relevance in the inference process (Smith et al., 2015). Thus, both the specific role of the subject of packaging images on consumer perception and the mechanisms by which those images are interpreted have often been overlooked. By taking an interdisciplinary approach, the work compiled in this thesis addressed these issues by studying how manipulating the image subject influences consumer expectations, perception and response towards the product and investigating the mechanisms by which consumers interpret those images.

Throughout six research studies, the work reported here shows that the properties of the products depicted on the packaging tend to influence the evaluation of the product contained within, since both perception and response depend on what is depicted on the image (although the effects are stronger in expectations than in perception during tasting). In addition, our findings show that the congruence between the image's possible meanings and the product potential attributes plays a key role in how the image is interpreted, and that the mechanism underlying this interpretation may be in part explained through affective mediation. A general discussion of these findings is outlined below in relation to the thesis objectives.

4.1.1. Objective 1: How manipulating the subject shown on packaging imagery influences consumer expectations, perception and response towards the product

The six research studies compiled in this dissertation aimed to investigate, through slightly different approaches, whether manipulating the subject of packaging imagery (i.e. what is displayed and how it is depicted) affects consumer perception and response **(objective 1)**. In this regard, our findings contribute to the literature by showing that consumer perception and response depend on the way in which the product is depicted (**studies 1**, p. 57; **4**, p. 119), the images chosen to convey a product attribute (**studies 2**, p. 67; **5**, p. 131; **6**, p. 145) or the products shown accompanying the main product in the serving suggestion (**Study 3**, p. 109). Specifically, we demonstrate that what is depicted on the image biases how the product is perceived, since consumers tend to project the

attributes of the image subject into the product. Thus, consumers tend to expect that crisps will be crunchier if depicted ready for consumption rather than during the elaboration process (**Study 1**, p. 57), or that soft cheese will be sweeter if shown together with a sweet product in the serving suggestion than if shown together with a salty product (**Study 3**, p. 109).

These findings are in line with prior research where a similar heuristic judgement has been reported, both regarding food extrinsic cues (e.g. Bell, Meiselman, Pierson, & Reeve, 1994; Celhay et al., 2015; North, Hargreaves, & McKendrick, 1997, 1999; Spence, 2018a) and the specific case of packaging imagery (e.g. Bone & France, 2001; Gvili et al., 2015; Gvili et al., 2017; Machiels & Karnal, 2016; Madzharov & Block, 2010; Smith et al., 2015; Szocs & Lefebvre, 2017). Indeed, during the development of this thesis, studies on the effects of manipulating the subject of the image have been published with results that support those presented here. Thus, Machiels & Karnal (2016) showed that consumers rely on the image to infer product naturalness, as depicting the food unprocessed (a raw orange) rather than processed (a glass of orange juice) enhances perceived taste pureness, which in turn increases purchase intentions (although the effect was only significant for consumers who are health-conscious and search for symbolic meaning). Moreover, Szocs & Lefebvre (2016) demonstrated that altering the physical state in which the product is depicted (e.g. solid, liquid) influences healthfulness perception and thereby product consumption.

Overall, these effects can be explained in terms of dual-process theories and heuristic judgement (Gawronski & Creighton, 2013; Madzharov & Block, 2010; Nickerson, 1998). Food shopping has been shown to be a low-involvement process, since consumers spend limited amounts of time and cognitive resources evaluating products and deciding which to choose (Park et al., 1989). Thus, people unconsciously use heuristics to make judgements regarding the attributes and benefits of a food product, relying on the information available at the time (such as the product's package; Lee et al., 2013). Previous research has shown that packaging imagery quickly draws consumer attention (Honea & Horsky, 2012; Rebollar et al., 2015; Venter, van der Merwe, de Beer, Kempen, & Bosman, 2011), and that consumers rely on the images depicted on food packaging to infer product information (Schifferstein et al., 2013). Since judgements tend to be influenced by first impressions (Epley & Gilovich, 2006; Lindgaard, Fernandes, Dudek, & Brown, 2006; see also Smith et al., 2015), it is reasonable to think that expectations elicited by imagery may anchor subsequent product evaluations, so that confirmation bias will

make the overall product evaluation to be consonant with the first impression raised by the images (Nickerson, 1998; Westerman et al., 2013). This is in line with the study conducted by Madzharov & Block (2010), which demonstrated that a similar anchoring effect occurs regarding the number of product units depicted on the package as consumers tend to estimate the number of product units contained within a package depending on the number of units depicted on it. Similarly, several studies have addressed the presence of a halo effect by which consumers tend to correlate the assessments of different product attributes (Lee et al., 2013; Leuthesser, Kohli, & Harich, 1995; Westerman et al., 2013), making consumers prone to make erroneous inferences (e.g. as with the health halo effect, Schuldt et al., 2012; Schuldt & Schwarz, 2010; Skaczkowski, Durkin, Kashima, & Wakefield, 2016; Sütterlin & Siegrist, 2015). Our results contribute to this body of literature by showing that packaging imagery anchors consumer perception and response towards the product.

However, it should be noted that the effect of packaging imagery on expectations is stronger than in perception during tasting, as demonstrated by results from **Study 4** (p. 119). This is in line with findings from other studies conducted in this vein (Levitan & Shermer, 2014; Wang, Keller, & Spence, 2017; Woods et al., 2011; Woods, Poliakoff, Lloyd, Dijksterhuis, & Thomas, 2010). For example, results from three experiments carried out by Tu et al. (2016) show that the colour of the plate influences both spiciness expectations and perception, yet the effect is stronger for the former. Indeed, although expectations largely influence consumption during tasting, it is worth noting that they are not the only factor contributing to the overall product experience (Piqueras-Fiszman & Spence, 2015; Spence, 2015a, 2018b). As results from **Study 4** (p. 119) also show, individual differences are another factor to be considered as contributing to perception, since women were more sensitive than men to the manipulation of the image depicted on the package. This is in line with prior research like that of Rebollar et al. (2017), the results of which indicate that women are more sensitive to the effect of illuminance than men, as women perceived a sample of natural yoghurt as being sweeter under high (vs low) illuminance (cf. Running & Hayes, 2016). Although other individual differences such as need for cognition (Deliza et al., 2003), design sensitivity (Becker et al., 2011; Celhay & Trinquecoste, 2014), health consciousness (Machiels & Karnal, 2016) or metaphor processing (Machiels & Karnal, 2016) had been previously addressed regarding packaging perception, our findings contribute to the literature by showing that gender also moderates consumer response to packaging imagery manipulations.

4.1.2. Objective 2: How consumers infer meaning from an ambiguous image

On the other hand, **studies 5** (p. 131) and **6** (p. 145) aimed to investigate the processes by which consumers infer meaning from an ambiguous image **(objective 2)**. Images are known to be propositionally indeterminate, which implies that they can be interpreted in different ways (e.g. according to the case analysed in **Study 6** (p. 145), an image of fire depicted on a nuts package may be interpreted as being roasted or as being spicy). This poses a challenge to designers, as they need to anticipate how the images will be decoded in order to make sure that packaging imagery elicits the intended message. In this regard, results from these studies contribute to the literature demonstrating that the interpretation given to an image depicted on a package depends on the congruence between the image's possible meanings and the product potential attributes (**Study 5**, p. 131), on the image shape (**Study 6**, p. 145) and on the affective response raised by the image (**Study 6**, p. 145). In addition, results from **Study 5** (p. 131) show that the cognitive effort needed to interpret an image with a metaphorical rhetorical style is higher than the cognitive effort required to interpret an image with a literal rhetorical style. These findings emphasize the complexity of the process by which consumers interpret packaging imagery, since they reveal that several processes interact to set the definitive meaning of an ambiguous image.

Although the underlying mechanisms explaining these findings are discussed in detail in each study, it is worth noting that overall these results support prior research that suggest that packaging conveys meaning through each of its different cues (Ares et al., 2011; Celhay & Remaud, 2018; Piqueras-Fiszman et al., 2011; Smith et al., 2015; Smith et al., 2010), since our findings indicate that consumer interpretation may be shaped by manipulating the image depicted on the package. This is in line with approaches that propose that communication is a key part of design (Crilly, Good, Matravers, & Clarkson, 2008; Crilly, Moultrie, & Clarkson, 2004; Frascara, 1988; Munari, 1973/2016), and highlights the importance of designing each packaging cue considering what will be its role in the communication process. Indeed, literature shows that cue congruence facilitates stimulus processing, thereby positively influencing attitudes and beliefs towards the product (Spence, 2018a; Van Rompay & Pruyn, 2011). In contrast, cue incongruence may draw confusion or deception, which in turn may lead to a disconfirmation of expectations (Deliza & MacFie, 1996; Piqueras-Fiszman & Spence, 2015) or to suboptimal food choices (Smith et al., 2015, 2010). It should be noted that cue incongruence may

happen even when explicit verbal information is provided, as it often interacts with other package cues in order to create meaning (Orth & Malkewitz, 2008). In this line, **studies 1** (p. 57), **2** (p. 67), **3** (p. 109) and **4** (p. 119) support prior research and demonstrate that consumer perception may be affected by packaging visual cues even when verbal information remains the same (e.g. Bone & France, 2001; Schuldt, 2013). According to the literature, this implies that textual claims per se are not enough to avoid confusing and deceptive interpretations of a package, since the paths by which the meanings of texts and images are decoded are different and thus can lead to different interpretations (Lewis & Walker, 1989). In that case, an additional process is required in order to select a definitive meaning, which can negatively affect the processing fluency and the overall attitude toward the product, even if the elicited meaning is correct (Alter & Oppenheimer, 2009).

Thus, designers have to understand and disentangle the communication codes by which consumers operate in order to foresee how images will be interpreted, so as to achieve the congruence of all packaging cues and stimulate the desired response (Ares et al., 2011; Orth & Malkewitz, 2008; Piqueras-Fiszman et al., 2011). Many studies have addressed this issues by taking a semiotic approach (Ares et al., 2011; Celhay et al., 2015; Celhay & Remaud, 2018; Mick, Burroughs, Hetzel, & Brannen, 2004; Opperud, 2004; Oswald, 2015; Piqueras-Fiszman et al., 2011; Smith et al., 2015), since semiotics provides a theoretical framework by which to understand how packaging visual cues generate meaning to consumers (Celhay & Remaud, 2018). The results reported in this dissertation take a step forward by specifically examining the mechanisms by which consumers interpret packaging imagery, and by doing so, experimentally assessing the implicit associations generated by the images.

4.1.3. Practical implications

Taken together, these findings offer interesting insights into how consumers process and interpret packaging imagery. Our results seem to show that the attributes of what is depicted on packaging anchor consumers' judgements, affecting how the product within is evaluated and perceived. These are empirical results that need to be further tested to yield a comprehensive process model, and therefore caution is needed before drawing definite conclusions from the findings reported here. Nevertheless, a number of design tips can be derived from the observations of this thesis.

Deciding whether to use visual or verbal cues in order to convey product information

First, our results suggest that when it comes to conveying product information through packaging, it may be a good idea to decide which kind of cue (visual or verbal) is more appropriate depending on the perceived valence of the attributes to be conveyed (i.e. whether those attributes are regarded by consumers as positive or negative). Images are considered to be more vivid and salient that texts, and therefore are commonly processed prior to textual claims (Kisielius & Sternthal, 1984; Rebollar et al., 2015; Underwood & Klein, 2002). In this way, they may anchor subsequent consumer judgements. Thus, if the product information to be conveyed is perceived as positive (as tested in **Study 1**, p. 57), using images rather than texts may enhance consumer expectations and response. Conversely, relying on packaging imagery to communicate product attributes that are not unequivocally positive, such as sweetness (which may be appealing from a sensory point of view, but ambivalent about whether the product is healthy) may negatively affect consumer attitude (as is suggested in **Study 2**, p. 67). Further studies should address issues such as the validity of these conclusions, or the moderating role of individual differences (where, for example, we would expect a bigger effect for consumers with a strong focus on health promotion).

Conveying information through packaging imagery

The results from all six studies support the notion that packaging imagery plays a key role in setting consumer expectations. They show that this effect can be used by designers to convey product information, and also by consumers to infer the product attributes (regardless of whether it was intended). This implies that designers should be cautious when choosing what images to depict, since consumers may use them to form expectations and, therefore, images may influence consumers' attitudes and responses. Specifically, results from the six studies indicate that consumers tend to apply to the product the more prominent attributes of the images depicted on its packaging. This can be seen when the appearance of the main product is manipulated (**studies 1**, p. 57, and **4**, p. 119), or when other products are shown (**Study 3**, p. 109), or when the image is used to convey a specific product attribute (**studies 2**, p. 67; **5**, p. 131; and **6**, p. 145). For example, according to our results, a designer could convey product healthfulness by depicting healthy products on the packaging; and convey its sweetness either by displaying sweet products or by manipulating its appearance (as is elaborated in **Study 4**, p. 119). In

addition, the features of the image can also be used to favour a preferred interpretation, as can be seen in **Study 6** (p. 145). Hence, for example, the designer could convey product spiciness by displaying spicy products in the package's serving suggestion, by means of a metaphorical image (such as fire; **studies 5**, p. 131, and **6**, p. 145) or by using angular and pointed shapes rather than rounded ones.

Favouring the image's desired interpretation

Finally, our results give some insights that allow designers to modulate consumer interpretation and to favour the desired meaning. As has already been discussed, whereas the results of **Study 5** (p. 131) highlight the key role that the congruence between the image's possible meanings and the product's potential attributes has on driving consumer interpretation, the findings from **Study 6** (p. 145) show that that interpretation may be modulated by manipulating the image's shape. Thus, it may be reasonable to expect that consumer confusion will be maximised if an image whose shape has been manipulated to be strongly associated with a given meaning is displayed together with a product whose potential attributes are incongruent with that meaning (e.g. depicting an angular fire image on a yoghurt package). Accordingly, the contrary should occur and confusion may be minimised if such an image is displayed together with a product whose potential attributes are congruent with that meaning (e.g. depicting an angular fire image on a chili package). Indeed, there are grounds to expect that this latter combination would help to reduce consumers' cognitive effort even in the case of images with a metaphorical rhetorical style (although this should be tested explicitly in further research).

4.2. Methods used

Regarding the methods followed in this thesis, it is worth noting that several measurement techniques have been used according to the objectives of each study. Thus, whereas explicit self-assessment methods have been used in all the six studies (mainly, Likert-7 scales) due to their reliability and their easiness (Ares & Varela, 2018a; Asioli et al., 2016; Hendrick et al., 2013; Petty & Cacioppo, 1996; Thomas & Chambault, 2016), other techniques such as word association (**Study 2**, p. 67) or speeded classification tasks (**studies 5**, p. 131, and **6**, p. 145) have also been conducted. Specifically, word association allowed us to qualitatively examine the associations raised by each of the images used to convey sweetness in **Study 2** (p. 67). It is a projective technique commonly used in the fields of psychology and sociology (Schmitt, 1998) which has also been increasingly used to study the effects of consumer perception of food (Esmerino et al., 2017; Guerrero et al., 2010; Roininen, Arvola, & Lähteenmäki, 2006). Our results support previous research, as it has proven to be useful in order to investigate how packaging cues affect consumer perception (Ares & Deliza, 2010; Carrillo, Fiszman, Lähteenmäki, & Varela, 2014; Piqueras-Fiszman et al., 2013). As for the speeded classification tasks, both **Study 5** (p. 131) and **Study 6** (p. 145) followed the procedure used by Semin & Palma (2014). This kind of technique allows reducing the level of reasoning of the participants (De Houwer et al., 2009), thus giving access to more implicit associations than those accessed through explicit tasks (Bar-Anan & Nosek, 2014; Kraus & Piqueras-Fiszman, 2018; Nosek et al., 2011). Commonly used in psychology (Bar-Anan & Nosek, 2014; Goodall, 2011), our results add to the literature showing that speeded classification tasks can also be used to assess semiotic meanings generated by packaging imagery (for similar uses regarding other packaging cues, see e.g. Karnal et al., 2016; Mai et al., 2016; Parise & Spence, 2012; Piqueras-Fiszman & Spence, 2011; Piqueras-Fiszman et al., 2012). Given that some researchers have suggested that this type of task can

also be conducted online without compromising its reliability (Chetverikov & Upravitelev, 2016), it is expected that the number of studies using these techniques will continue to increase in the future.

As for the ecological validity of the experiments, stimuli designed for all studies were created following the findings of market studies conducted beforehand. This allowed us to (1) identify the visual codes of the chosen product categories, which in turn allowed us to design realistic packages with which to make the experience more immersive for the participants; and (2) enhance the interest and applicability of our findings by selecting realistic case studies which represent common design concerns. Moreover, **Study 4** (p. 119) was conducted by using tangible mock-up packages, so that participants could manipulate them during the tasting. This contributes to boosting both the realism of the setting and participant engagement, since participants are less prone to be aware of the true aim of the experiment (Bangcuyo et al., 2015).

4.3. Limitations and future work

Beyond its contributions, the work reported in this thesis has some limitations that should be taken into account. Regarding the participants who took part in the six studies compiled in this dissertation, it should be noted that they were mostly recruited in a Spanish university context, so a bias regarding their diversity and features should not be ruled out. Although our findings are in line with previous research conducted in other contexts, further testing would be needed in order to see if these results could be extrapolated to other markets and other cohorts of consumers. In addition, it is worth noting that some of the studies have modest sample sizes (such as the word association conducted in **Study 2,** p. 67), so further work is advised in order to test the validity of their results. Moreover, some studies followed a within participants design (**studies 1**, p. 57; **2**, p. 67; **3**, p. 109; **5**, p. 131; and **6**, p. 145) whereas others followed a between participants design (**studies 2**, p. 67; **4**, p. 119; and **5**, p. 131), so it is not easy to compare their conclusions due to the practical effects that each kind of study may carry for the marketplace (e.g. Keren, 1993). Furthermore, all studies were conducted in a laboratory setting, so it is reasonable to think that the effects reported here may be modulated in a real consumption context (Lawless & Heimann, 2010).

As has been previously discussed, the main experiments reported in **studies 5** (p. 131) and **6** (p. 145) were conducted by means of speeded classification tasks with the intention of accessing the implicit associations of the consumers (De Houwer et al., 2009). However, some researchers have questioned whether the documented associations are automatically produced in the mind (Spence & Deroy, 2013) and whether this kind of task is able to really access purely implicit associations (De Houwer et al., 2007). In addition, while literature suggests that a lower cognitive effort is related to a better consumer attitude (Alter & Oppenheimer, 2009), it is not clear whether latencies of a speeded classification

task really represent processing fluency (Graf, Mayer, & Landwehr, 2017). Thus, since consumer hedonic response was not measured in those experiments, one should be cautious regarding the implicit nature of the results and their effect on consumer attitude.

The underlying mechanisms explaining the effects reported in **studies 1** (p. 57), **2** (p. 67), **3** (p. 109) and **4** (p. 119) have been mainly discussed in terms of a confirmation bias (Nickerson, 1998), since we argue that consumers tend to assign the attributes of what is depicted on the image into the product contained within the package (although note that in the case of **Study 4**, p. 119, it can be argued that it is not clear whether the effects obtained are driven by just colour or the image as a whole; see e.g. Spence et al., 2015). Yet this effect has not been explicitly addressed in the work reported here. Indeed, it is not easy to disentangle how much of the effect of a visual cue can be explained through semiotic/symbolic associations and how much is rather attributed to its truly implicit impact on perception and response (Spence, 2018a). Explicitly studying the difference between how packaging imagery is perceived and how the overall product is perceived could be a step forward in this direction, as it would allow assessing the actual contribution of the images to the overall perception. In addition, our results are in line with the literature suggesting that the perception of certain product attributes (such as healthfulness, naturalness or quality) are positively correlated with the willingness to buy (e.g. Annett et al., 2008; Ares et al., 2008; Bower et al., 2003; Fernqvist & Ekelund, 2014; Lee et al., 2013; Machiels & Karnal, 2016; Román et al., 2017), whereas other product attributes (such as sweetness) seem to be somewhat negatively correlated through indirect means due to their association with low health benefits (e.g. Lustig, Schmidt, & Brindis, 2012; Rebollar et al., 2017). However, this causal relationship has not been addressed in this thesis, so no robust conclusions can be drawn in this regard. Although not directly related to the scope of the present dissertation, we believe that delving deeper in these mechanisms would help designers and producers to better understand the drivers of consumer behaviour.

Overall, it is worth noting that this dissertation is but a modest approach to the challenge of understanding the effect of packaging imagery on consumer perception and response, and it is by no means exhaustive. Much work remains to be done in order to broaden our comprehension of these processes. Given the interdisciplinary nature of the research conducted in this thesis, that relies on conceptual frameworks from fields such as semiotics, psycho-

logy, consumer behavior or design, next steps should be aimed to develop a cohesive conceptual and theoretical framework in which to include and discuss how each theory contributes in disentangling the processes by which packaging imagery affects consumer perception. In fact, although our findings represent a small step forward in the direction of understanding the mechanisms by which consumers interpret imagery, many questions remain unanswered. For example, it remains unknown how consumers discriminate meaning when there is more than one image on the package, or how a meaning is selected when the image has more than two possible interpretations. In addition, digging more into the literature about image rhetoric would be interesting to investigate tropes other than metaphors (Scott, 1994). Thus, further research is needed in order to address these and other questions aimed at better understanding interpretation processes. Indeed, there is more and more research devoted to investigating how certain meanings can be conveyed through packaging cues, so new lines of research should be aimed to investigate how packaging imagery can be used to convey concepts such as healthiness, naturalness or sustainability. Moreover, although previous research has shown the moderating role of consumer individual differences on the perceptual processes (Celhay & Remaud, 2018; Deliza et al., 2003; Machiels & Karnal, 2016; Running & Hayes, 2016), this issue has not been explored in depth in this thesis as just the effect of gender has been addressed (**Study 4**, p. 119). Specifically, design sensitivity is particularly relevant from a design point of view (Bloch, Brunel, & Arnold, 2003), so future lines of research should investigate its possible moderating role in the effects exerted by packaging imagery.

5. CONCLUSIONS

5.1. Conclusions

The findings reported in this dissertation highlight the key role that packaging imagery plays on consumer perception and response. Throughout six research studies, the objectives of this thesis have been fulfilled, as it has been demonstrated that the images depicted on food packaging (1) may affect perception and response towards the product contained within, and (2) can be used to modulate consumer interpretation. This has potential implications for both designers and policy makers, since it is shown that the way in which consumers perceive and consume a product may be modulated by manipulating the images depicted on its packaging.

During the design process, designers have to make many decisions regarding the visual appearance of the packaging and, specifically, the imagery depicted on it. Although there is a rich body of research devoted to studying consumer psychology and how the design outcomes affect perception and response, it is not easy for designers to apply the findings of the scientific literature in their everyday work. Thus, design is commonly based on designers' practical experience and common sense rather than on empirical evidence from semiotics, cognition or other related fields. This thesis contributes in this regard by addressing common concerns of packaging designers, and albeit its results have to be further tested in order to check their validity, they seem to offer some insights that can be useful during the design process. For example, these findings suggest that if a positive product attribute has to be conveyed through the package, it may be a good idea to do so by depicting an image as it may enhance consumer expectations and willingness to buy. Yet, these results also show that it matters what (and how) is depicted on the image, since a poor image choice can have a more negative effect than not displaying an image at all (even in the case of congruent and positive-valenced imagery).

Finally, from a public policy point of view, this thesis adds to the growing evidence that highlights the key role that packaging cues other than textual claims play on food choice and consumer behaviour. Specifically, the work reported here pinpoints that the perception of certain product attributes and benefits may be enhanced through packaging imagery, so it could also be used to mislead consumers by making unhealthful products look more healthful and thereby favouring suboptimal product choices. It is a risk that should not be overlooked, and thus these insights are also of interest to policy makers who watch over consumer rights and health promotion.

5.2. Conclusiones

Los resultados de la presente tesis subrayan el papel clave que juegan las imágenes mostradas en los envases en los procesos de percepción y respuesta del consumidor. Los objetivos de la tesis se han cumplido a lo largo de seis estudios de investigación, en los que se ha demostrado que las imágenes mostradas en los envases alimentarios (1) pueden influir en la percepción y respuesta hacia el producto contenido en su interior, y (2) pueden emplearse para modular la interpretación del consumidor. Esto tiene implicaciones potenciales tanto para diseñadores como para agentes políticos, puesto que se muestra que el modo en que los consumidores perciben y consumen un producto puede modularse manipulando las imágenes mostradas en su envase.

Durante el proceso de diseño, los diseñadores tienen que tomar muchas decisiones relativas a la apariencia visual del envase y, específicamente, las imágenes mostradas en él. Aunque hay gran cantidad de trabajos dedicados a estudiar la psicología del consumidor y cómo las decisiones de diseño afectan su percepción y respuesta, para los diseñadores no es fácil aplicar las conclusiones de la literatura científica en su trabajo cotidiano. Así, la experiencia práctica y el sentido común de los diseñadores influye más en el resultado de sus diseños que la evidencia empírica hallada en campos como la semiótica, la cognición u otras áreas relacionadas. Esta tesis contribuye en este aspecto abordando situaciones y dilemas cotidianos a los que se efrentan los diseñadores en su día a día, y aunque sus resultados deben ser refrendados por futuras investigaciones que permitan asegurar su validez, parecen ofrecer pistas que pueden ser útiles durante el proceso de diseño. Por ejemplo, estos resultados sugieren que si se quiere comunicar un atributo positivo del producto a través del envase, puede ser buena idea hacerlo usando una imagen puesto que ello potencia las expectativas y la predisposición a la compra del consumidor. Sin embargo, estos resultados también muestran que importa qué (y cómo) es representado en la imagen, puesto

que mostrar una imagen inadecuada puede tener un efecto más negativo que no mostrar ninguna (incluso en el caso de imágenes congruentes y positivas).

Por último, desde el punto de vista de las políticas públicas, esta tesis se suma a la creciente evidencia que destaca el papel fundamental que los elementos del envase, más allá de los textuales, juegan sobre la elección de los alimentos y el comportamiento del consumidor. Específicamente, la presente tesis demuestra que las imágenes mostradas en el envase pueden mejorar la percepción de ciertos atributos y beneficios del producto, lo que también puede utilizarse para inducir a error a los consumidores haciendo que productos no saludables sean percibidos como saludables, favoreciendo así la elección de productos indeseados. Este es un riesgo que no debe pasarse por alto y, por lo tanto, estos hallazgos también son de interés para los agentes políticos encargados de velar por los derechos del consumidor y la promoción de la salud.

6. REFERENCES

Alter, A. L., & Oppenheimer, D. M. (2009). Uniting the Tribes of Fluency to Form a Metacognitive Nation. *Personality and Social Psychology Review*, *13*(3), 219–235. https://doi.org/10.1177/1088868309341564

Ampuero, O., & Vila, N. (2006). Consumer perceptions of product packaging. *Journal of Consumer Marketing*, *23*(2), 100–112. https://doi.org/10.1108/07363760610655032

Andersen, B. V., Brockhoff, P. B., & Hyldig, G. (2018). The importance of liking of appearance, -odour, -taste and -texture in the evaluation of overall liking. A comparison with the evaluation of sensory satisfaction. *Food Quality and Preference*. https://doi.org/10.1016/j.foodqual.2018.07.005

Annett, L. E., Muralidharan, V., Boxall, P. C., Cash, S. B., & Wismer, W. V. (2008). Influence of health and environmental information on hedonic evaluation of organic and conventional bread. *Journal of Food Science*, *73*(4). https://doi.org/10.1111/j.1750-3841.2008.00723.x

Arboleda, A. M., & Arce-Lopera, C. (2015). Quantitative analysis of product categorization in soft drinks using bottle silhouettes. *Food Quality and Preference*, *45*, 1–10. https://doi.org/10.1016/j.foodqual.2015.04.006

Ares, G., & Deliza, R. (2010). Studying the influence of package shape and colour on consumer expectations of milk desserts using word association and conjoint analysis. *Food Quality and Preference*, *21*(8), 930–937. https://doi.org/10.1016/j.foodqual.2010.03.006

Ares, G., Giménez, A., & Gámbaro, A. (2008). Does information about the source of functional ingredients influence consumer perception of functional milk desserts? *Journal of the Science of Food and Agriculture*, *88*(12), 2061–2068. https://doi.org/10.1002/jsfa.3313

Ares, G., Piqueras-Fiszman, B., Varela, P., Marco, R. M., López, A. M., & Fiszman, S. (2011). Food labels: Do consumers perceive what semiotics want to convey? *Food Quality and Preference*, *22*(7), 689–698. https://doi.org/10.1016/j.foodqual.2011.05.006

Ares, G., & Varela, P. (Eds.). (2018a). *Methods in Consumer Research, Volume 1: New Approaches to Classic Methods*. Cambridge, MA: Woodhead Publishing.

Ares, G., & Varela, P. (Eds.). (2018b). *Methods in Consumer Research, Volume 2: Alternative Approaches and Special Applications*. Cambridge, MA: Woodhead Publishing.

Asioli, D., Varela, P., Hersleth, M., Almli, V. L., Olsen, N. V., & Næs, T. (2016). A discussion of recent methodologies for combining sensory and extrinsic product properties in consumer studies. *Food Quality and Preference*. https://doi.org/10.1016/j.foodqual.2016.03.015

Aslam, M. M. (2006). Are you selling the right colour? A cross-cultural review of colour as a marketing cue. *Journal of Marketing Communications*, *12*(1), 15–30. https://doi.org/10.1080/13527260500247827

Azzi, A., Battini, D., Persona, A., & Sgarbossa, F. (2012). Packaging Design: General Framework and Research Agenda. *Packaging Technology and Science*, *25*, 435–456. https://doi.org/10.1002/pts.993

Bangcuyo, R. G., Smith, K. J., Zumach, J. L., Pierce, A. M., Guttman, G. A., & Simons, C. T. (2015). The use of immersive technologies to improve consumer testing: The role of ecological validity, context and engagement in evaluating coffee. *Food Quality and Preference*, *41*, 84–95. https://doi.org/10.1016/j.foodqual.2014.11.017

Bar-Anan, Y., & Nosek, B. A. (2014). A comparative investigation of seven indirect attitude measures. *Behavior Research Methods*, *46*(3), 668–688. https://doi.org/10.3758/s13428-013-0410-6

Barthes, R. (1977). Rhetoric of the Image. In S. Heath (Ed.), *Image-Music-Text* (pp. 32–51). New York: Hill and Wang.

Becker, L., van Rompay, T. J. L., Schifferstein, H. N. J., & Galetzka, M. (2011). Tough package, strong taste: The influence of packaging design on taste impressions and product evaluations. *Food Quality and Preference*, *22*(1), 17–23. https://doi.org/10.1016/j.foodqual.2010.06.007

Bell, R., Meiselman, H. L., Pierson, B. J., & Reeve, W. G. (1994). Effects of Adding an Italian Theme to a Restaurant on the Perceived Ethnicity, Acceptability, and Selection of Foods. *Appetite*, *22*(1), 11–24. https://doi.org/10.1006/appe.1994.1002

Biggs, L., Juravle, G., & Spence, C. (2016). Haptic exploration of plateware alters the perceived texture and taste of food. *Food Quality and Preference*, *50*, 129–134. https://doi.org/10.1016/j.foodqual.2016.02.007

Bloch, P. H. (1995). Seeking the Ideal Form: Product Design and Consumer Response. *Journal of Marketing*, *59*(3), 16–29. https://doi.org/10.2307/1252116

Bloch, P. H., Brunel, F. F., & Arnold, T. J. (2003). Individual Differences in the Centrality of Visual Product Aesthetics: Concept and Measurement. *Journal of Consumer Research*, *29*(4), 551–565. https://doi.org/10.1086/346250

Bone, P. F., & France, K. R. (2001). Package graphics and consumer product beliefs. *Journal of Business and Psychology*, *15*(3), 467–489. https://doi.org/10.1023/A:1007826818206

Bottomley, D. A., Doyle, J. R., & Bottomley, P. A. (2002). Dressed for the Occasion: Font-Product Congruity in the Perception of Logotype. *McCarThy & Mothersbaugh*, *16*(2), 112–123.

Bower, J. A., Saadat, M. A., & Whitten, C. (2003). Effect of liking, information and consumer characteristics on purchase intention and willingness to pay more for a fat spread with a proven health benefit. *Food Quality and Preference*, *14*(1), 65–74. https://doi.org/10.1016/S0950-3293(02)00019-8

Bringhurst, R. (2004). *The Elements of Typographic Style*. Point Roberts, WA: Hartley & Marks.

Byrne, K. (1990). A "semantics" of visual design: the care and feeding of studio projects within a communication-theory context. *Design Studies*, *11*(3), 141–163. https://doi.org/10.1016/0142-694X(90)90003-U

Caporale, G., Policastro, S., Carlucci, A., & Monteleone, E. (2006). Consumer expectations for sensory properties in virgin olive oils. *Food Quality and Preference*, *17*(1), 116–125. https://doi.org/10.1016/j.foodqual.2005.07.011

Cardello, A. V. (2007). Measuring consumer expectations to improve food product development. In H. J. H. MacFie (Ed.), *Consumer-Led Food Product Development* (pp. 223–261). Cambridge: Elsevier. https://doi.org/10.1533/9781845693381.2.223

Carrillo, E., Fiszman, S., Lähteenmäki, L., & Varela, P. (2014). Consumers' perception of symbols and health claims as health-related label messages. A cross-cultural study. *Food Research International*, *62*, 653–661. https://doi.org/10.1016/j.foodres.2014.04.028

Carter, R., Meggs, P. B., Day, B., Maxa, S., & Sanders, M. (2015). *Typographic Design: Form and Communication* (6th ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Castonguay, J., Kunkel, D., Wright, P., & Duff, C. (2013). Healthy characters? An investigation of marketing practices in children's food advertising. *Journal of Nutrition Education and Behavior*, *45*(6), 571–577. https://doi.org/10.1016/j.jneb.2013.03.007

Cavanagh, K. V., Kruja, B., & Forestell, C. a. (2014). The effect of brand and caloric information on flavor perception and food consumption in restrained and unrestrained eaters. *Appetite*, *82*, 1–7. https://doi.org/10.1016/j.appet.2014.06.100

Celhay, F., Boysselle, J., & Cohen, J. (2015). Food packages and communication through typeface design: The exoticism of exotypes. *Food Quality and Preference*, *39*, 167–175. https://doi.org/10.1016/j.foodqual.2014.07.009

Celhay, F., & Remaud, H. (2018). What does your wine label mean to consumers? A semiotic investigation of Bordeaux wine visual codes. *Food Quality and Preference*, *65*(November 2017), 129–145. https://doi.org/10.1016/j.foodqual.2017.10.020

Celhay, F., & Trinquecoste, J. F. (2014). Package Graphic Design: Investigating the Variables that Moderate Consumer Response to Atypical Designs. *Journal of Product Innovation Management*, *32*(6), 1014–1032. https://doi.org/10.1111/jpim.12212

Chetverikov, A., & Upravitelev, P. (2016). Online versus offline: The Web as a medium for response time data collection. *Behavior Research Methods*, *48*(3), 1086–1099. https://doi.org/10.3758/s13428-015-0632-x

Childers, T. L., & Jass, J. (2002). All Dressed Up With Something to Say: Effects of Typeface Semantic Associations on Brand Perceptions and Consumer Memory. *Journal of Consumer Psychology*, *12*(2), 93–106. https://doi.org/10.1207/S15327663JCP1202_03

Chitturi, R., Raghunathan, R., & Mahajan, V. (2008). Delight by Design: The Role of Hedonic Versus Utilitarian Benefits. *Journal of Marketing*, *72*(3), 48–63. https://doi.org/10.1509/jmkg.72.3.48

Chrysochou, P., & Grunert, K. G. (2014). Health-related ad information and health motivation effects on product evaluations. *Journal of Business Research*, *67*(6), 1209–1217. https://doi.org/10.1016/j.jbusres.2013.05.001

Clement, J. (2007). Visual influence on in-store buying decisions: an eye-track experiment on the visual influence of packaging design. *Journal of Marketing Management*, *23*(9–10), 917–928. https://doi.org/10.1362/026725707X250395

Clement, J., Kristensen, T., & Grønhaug, K. (2013). Understanding consumers' in-store visual perception: The influence of package design features on visual attention. *Journal of Retailing and Consumer Services*, *20*(2), 234–239. https://doi.org/10.1016/j.jretconser.2013.01.003

Creusen, M. E. H., & Schoormans, J. P. L. (2005). The different roles of product appearance in consumer choice. *Journal of Product Innovation Management*, *22*, 63–81. https://doi.org/10.1111/j.0737-6782.2005.00103.x

Crilly, N., Good, D., Matravers, D., & Clarkson, P. J. (2008). Design as communication: exploring the validity and utility of relating intention to interpretation. *Design Studies*, *29*(5), 425–457. https://doi.org/10.1016/j.destud.2008.05.002

Crilly, N., Moultrie, J., & Clarkson, P. J. (2004). Seeing things: Consumer response to the visual domain in product design. *Design Studies*, *25*(6), 547–577. https://doi.org/10.1016/j.destud.2004.03.001

De Houwer, J., Beckers, T., & Moors, A. (2007). Novel attitudes can be faked on the Implicit Association Test. *Journal of Experimental Social Psychology*, *43*(6), 972–978. https://doi.org/10.1016/j.jesp.2006.10.007

De Houwer, J., Teige-Mocigemba, S., Spruyt, A., & Moors, A. (2009). Implicit measures: A normative analysis and review. *Psychological Bulletin*, *135*(3), 347–368. https://doi.org/10.1037/a0014211

Deliza, R., MacFie, H., & Hedderley, D. (2003). Use of Computer-Generated Images and Conjoint Analysis To Investigate Sensory Expectations. *Journal of Sensory Studies*, *18*(6), 465–486. https://doi.org/10.1111/j.1745-459X.2003.tb00401.x

Deliza, R., & MacFie, H. J. H. (1996). The Generation of Sensory Expectation by External Cues and its Effect on Sensory Perception and Hedonic Ratings: a Review. *Journal of Sensory Studies*, *11*(2), 103–128. https://doi.org/10.1111/j.1745-459X.1996.tb00036.x

Deng, X., Hui, S. K., & Hutchinson, J. W. (2010). Consumer preferences for color combinations: An empirical analysis of similarity-based color relationships. *Journal of Consumer Psychology*, *20*(4), 476–484. https://doi.org/10.1016/j.jcps.2010.07.005

Deng, X., & Kahn, B. E. (2009). Is Your Product on the Right Side? The "Location Effect" on Perceived Product Heaviness and Package Evaluation. *Journal of Marketing Research*, *46*, 725–738. https://doi.org/10.1509/jmkr.46.6.725

Deng, X., & Srinivasan, R. (2013). When Do Transparent Packages Increase (or Decrease) Food Consumption? *Journal of Marketing*, *77*(5), 104–117. https://doi.org/10.1509/jm.11.0610

di Pellegrino, G., Magarelli, S., & Mengarelli, F. (2011). Food pleasantness affects visual selective attention. *Quarterly Journal of Experimental Psychology*, *64*(3), 560–571. https://doi.org/10.1080/17470218.2010.504031

Dijksterhuis, A. (2013). Automaticity. In D. E. Carlston (Ed.), *The Oxford handbook of social cognition* (pp. 239–256). Oxford, UK: Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199730018.013.0012

Dixon, H., Scully, M., Niven, P., Kelly, B., Chapman, K., Donovan, R., … Wakefield, M. (2014). Effects of nutrient content claims, sports celebrity endorsements and premium offers on pre-adolescent children's food preferences: Experimental research. *Pediatric Obesity*, *9*(2), e47–e57. https://doi.org/10.1111/j.2047-6310.2013.00169.x

Doyle, J. R., & Bottomley, P. A. (2004). Font appropriateness and brand choice. *Journal of Business Research*, *57*(8), 873–880. https://doi.org/10.1016/S0148-2963(02)00487-3

Doyle, J. R., & Bottomley, P. A. (2009). The massage in the medium: Transfer of connotative meaning from typeface to names and products. *Applied Cognitive Psychology*, *23*(3), 396–409. https://doi.org/10.1002/acp.1468

Epley, N., & Gilovich, T. (2006). The Anchoring-and-Adjustment Heuristic Why the Adjustments Are Insufficient. *Psychological Science*, *17*(4), 311–319.

Esmerino, E. A., Ferraz, J. P., Filho, E. R. T., Pinto, L. P. F., Freitas, M. Q., Cruz, A. G., & Bolini, H. M. A. (2017). Consumers' perceptions toward 3 different fermented dairy products: Insights from focus groups, word association, and projective mapping. *Journal of Dairy Science*, *100*(11), 8849–8860. https://doi.org/10.3168/jds.2016-12533

Estes, Z., & Jones, L. L. (2006). Priming via relational similarity: A copper horse is faster when seen through a glass eye. *Journal of Memory and Language*, *55*(1), 89–101. https://doi.org/10.1016/j.jml.2006.01.004

Fenko, A., Vries, R. De, & Rompay, T. Van. (2018). How Strong Is Your Coffee? The Influence of Visual Metaphors and Textual Claims on Consumers' Flavor Perception and Product Evaluation. *Frontiers in Psychology*, *9*(Feb), 1–12. https://doi.org/10.3389/fpsyg.2018.00053

Fernqvist, F., & Ekelund, L. (2014). Credence and the effect on consumer liking of food – A review. *Food Quality and Preference*, *32*(PC), 340–353. https://doi.org/10.1016/j.foodqual.2013.10.005

Fernqvist, F., Olsson, A., & Spendrup, S. (2015). What's in it for me? Food packaging and consumer responses, a focus group study. *British Food Journal*, *117*(3), 1122–1135. https://doi.org/10.1108/BFJ-08-2013-0224

Festila, A. (2016). *Health Metaphors of Package Design* (Doctoral dissertation, Aarhus University, Aarhus, Denmark). Retrieved from https://bit.ly/2mXM8Ix

Festila, A., & Chrysochou, P. (2018). Implicit communication of food product healthfulness through package design: A content analysis. *Journal of Consumer Behaviour*, (February 2017), 1–16. https://doi.org/10.1002/cb.1732

Fillmore, C. J., & Baker, C. (2010). A frames approach to semantic analysis. In B. Heine & H. Narrog (Eds.), *The Oxford Handbook of Linguistic Analysis* (pp. 313–340). Oxford: Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199544004.013.0013

Frascara, J. (1988). Graphic Design: Fine Art or Social Science? *Design Issues*, *5*(1), 18. https://doi.org/10.2307/1511556

Fulcher, E., Dean, A., & Trufil, G. (2016). Neurosense and Packaging: Understanding Consumer Evaluations Using Implicit Technology. In P. Burgess (Ed.), *Integrating the Packaging and Product Experience in Food and Beverages* (pp. 121–138). Woodhead Publishing. https://doi.org/10.1016/B978-0-08-100356-5.00006-1

Gagné, C. L., & Spalding, T. L. (2006). Using conceptual combination research to better understand novel compound words. *SKASE Journal of Theoretical Linguistics*, *3*(2), 9–16. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.163.5240&rep=rep1&type=pdf

Gawronski, B., & Creighton, L. A. (2013). Dual-process theories. In D. E. Carlston (Ed.), *The Oxford handbook of social cognition* (pp. 282–312). Oxford, UK: Oxford University Press. https://doi.org/10.1017/S0140525X03340130

Gawronski, B., & De Houwer, J. (2014). Implicit measures in social and personality psychology. In H. T. Reis & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology* (pp. 283–310). New York, NY, USA: Cambridge University Press.

Getz, L. M., & Kubovy, M. (2018). Questioning the automaticity of audiovisual correspondences. *Cognition*, *175*(August 2017), 101–108. https://doi.org/10.1016/j.cognition.2018.02.015

Gilbride, T. J., Inman, J. J., & Stilley, K. M. (2015). The Role of Within-Trip Dynamics in Unplanned Versus Planned Purchase Behavior. *Journal of Marketing*, *79*(3), 57–73. https://doi.org/10.1509/jm.13.0286

Goodall, C. E. (2011). An Overview of Implicit Measures of Attitudes: Methods, Mechanisms, Strengths, and Limitations. *Communication Methods and Measures*, *5*(3), 203–222. https://doi.org/10.1080/19312458.2011.596992

Graf, L. K. M., Mayer, S., & Landwehr, J. R. (2017). Measuring Processing Fluency: One versus Five Items. *Journal of Consumer Psychology*, Advance online publication. https://doi.org/10.1002/jcpy.1021

Greenwald, A. G., & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review*, *102*(1), 4–27. https://doi.org/10.1037/0033-295X.102.1.4

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: the implicit association test. *Journal of Personality and Social Psychology*, 74(6), 1464–1480. https://doi.org/10.1037/0022-3514.74.6.1464

Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the Implicit Association Test: An improved scoring algorithm. *Journal Pers Soc Psychol.*, *85*(2), 197–216. https://doi.org/10.1037/0022-3514.85.2.197

Gregan-Paxton, J., & John, D. R. (1997). Consumer Learning by Analogy: A Model of Internal Knowledge Transfer. *Journal of Consumer Research*, *24*(3), 266–284. https://doi.org/10.1086/209509

Guerrero, L., Claret, A., Verbeke, W., Enderli, G., Zakowska-Biemans, S., Vanhonacker, F., … Hersleth, M. (2010). Perception of traditional food products in six European regions using free word association. *Food Quality and Preference*, *21*(2), 225–233. https://doi.org/10.1016/j.foodqual.2009.06.003

Gvili, Y., Tal, A., Amar, M., Hallak, Y., Wansink, B., Giblin, M., & Bommelaer, C. (2015). Fresh from the tree: Implied motion improves food evaluation. *Food Quality and Preference*, *46*, 160–165. https://doi.org/10.1016/j.foodqual.2015.07.015

Gvili, Y., Tal, A., Amar, M., & Wansink, B. (2017). Moving up in taste: Enhanced projected taste and freshness of moving food products. *Psychology and Marketing*, *34*(7), 671–683. https://doi.org/10.1002/mar.21014

Hagtvedt, H., & Patrick, V. M. (2014). Consumer Response to Overstyling: Balancing Aesthetics and Functionality in Product Design. *Psychology & Marketing*, *31*(7), 518–525. https://doi.org/10.1002/mar.20713

Hembree, R. (2008). *The Complete Graphic Designer: A Guide to Understanding Graphics and Visual Communication*. Beverly: Rockport Publishers.

Hendrick, T. A. M., Fischer, A. R. H., Tobi, H., & Frewer, L. J. (2013). Self-reported attitude scales: Current practice in adequate assessment of reliability, validity, and dimensionality. *Journal of Applied Social Psychology*, *43*(7), 1538–1552. https://doi.org/10.1111/jasp.12147

Hine, T. (1995). *The total package: The secret history and hidden meanings of boxes, bottles, cans, and other persuasive containers*. New York, NY: Little Brown.

Hoegg, J., & Alba, J. W. (2008). A Role for Aesthetics in Consumer Psychology. In C. P. Haugtvedt, P. M. Herr, & F. R. Kardes (Eds.), *Handbook of consumer psychology* (pp. 733–754). New York: Taylor & Francis Group.

Hoegg, J., Alba, J. W., & Dahl, D. W. (2010). The good, the bad, and the ugly: Influence of aesthetics on product feature judgments. *Journal of Consumer Psychology*, *20*(4), 419–430. https://doi.org/10.1016/j.jcps.2010.07.002

Honea, H., & Horsky, S. (2012). The power of plain: Intensifying product experience with neutral aesthetic context. *Marketing Letters*, *23*(1), 223–235. https://doi.org/10.1007/s11002-011-9149-y

Jaeger, S. R., & MacFie, H. J. H. (2001). The effect of advertising format and means-end information on consumer expectations for apples. *Food Quality and Preference*, *12*(3), 189–205. https://doi.org/10.1016/S0950-3293(00)00044-6

Kahn, B. E., & Deng, X. (2010). Effects on visual weight perceptions of product image locations on packaging. In A. Krishna (Ed.), *Sensory Marketing: Research on the Sensuality of Products* (pp. 259–278). New York: Routledge.

Karmarkar, U. R., & Plassmann, H. (2015). Consumer neuroscience. Revealing meaningful relationships between brain and consumer behavior. In M. I. Norton, D. D. Rucker, & C. Lamberton (Eds.), *The Cambridge Handbook of Consumer Psychology* (pp. 152–179). Cambridge: Cambridge University Press. https://doi.org/10.1177/1094428117730598

Karnal, N., Machiels, C. J. A., Orth, U. R., & Mai, R. (2016). Healthy by design, but only when in focus: Communicating non-verbal health cues through symbolic meaning in packaging. *Food Quality and Preference*, *52*, 106–119. https://doi.org/10.1016/j.foodqual.2016.04.004

Kauppinen-Räisänen, H. (2014). Strategic Use of Colour in Brand Packaging. *Packaging Technology and Science*, *27*(8), 663–676. https://doi.org/10.1002/pts.2061

Kauppinen-Räisänen, H., Owusu, R. A., & Abeeku Bamfo, B. (2012). Brand salience of OTC pharmaceuticals through package appearance. *International Journal of Pharmaceutical and Healthcare Marketing*, *6*(3), 230–249. https://doi.org/10.1108/17506121211259403

Keren, G. (1993). Between- or within-subjects design: A methodological dilemma. In G. Keren & C. Lewis (Eds.), *A handbook for data analyses in the behavioural sciences: Methodological issues* (pp. 257–272). Hillsdale, NJ: Lawrence Erlbaum Associates.

Kim, M. K., Lopetcharat, K., & Drake, M. A. (2013). Influence of packaging information on consumer liking of chocolate milk. *Journal of Dairy Science*, *96*(8), 4843–4856. https://doi.org/10.3168/jds.2012-6399

Kisielius, J., & Sternthal, B. (1984). Detecting and Explaining Vividness Effects in Attitudinal Judgments. *Journal of Marketing Research*, *21*(1), 54–64. https://doi.org/10.2307/3151792

Klimchuk, M. R., & Krasovec, S. A. (2012). *Packaging Design: Successful Product Branding from Concept to Shelf*. New Jersey: John Wiley & Sons.

Knez, I., & Kers, C. (2000). Effects of Indoor Lighting, Gender, and Age on Mood and Cognitive Performance. *Environment and Behavior*, *32*(6), 817–831. https://doi.org/10.1177/00139160032600 5

Kobayashi, M. L., & Benassi, M. de T. (2015). Impact of Packaging Characteristics on Consumer Purchase Intention: Instant Coffee in Refill Packs and Glass Jars. *Journal of Sensory Studies*, 1–12. https://doi.org/10.1111/joss.12142

Kraus, A., & Piqueras-Fiszman, B. (2018). Measuring Implicit Associations in Food-Related Consumer Research. In G. Ares & P. Varela (Eds.), *Methods in Consumer Research, Volume 2: Alternative Approaches and Special Applications* (pp. 203–230). Cambridge, MA: Woodhead Publishing.

Krishna, A., Cian, L., & Aydınolu, N. Z. (2017). Sensory Aspects of Package Design. *Journal of Retailing*, *93*(1), 43–54. https://doi.org/10.1016/j.jretai.2016.12.002

Labbe, D., Pineau, N., & Martin, N. (2013). Food expected naturalness: Impact of visual, tactile and auditory packaging material properties and role of perceptual interactions. *Food Quality and Preference*, *27*(2), 170–178. https://doi.org/10.1016/j.foodqual.2012.06.009

Labrecque, L. I., & Milne, G. R. (2012). Exciting red and competent blue: The importance of color in marketing. *Journal of the Academy of Marketing Science*, *40*, 711–727. https://doi.org/10.1007/s11747-010-0245-y

Labrecque, L. I., Patrick, V. M., & Milne, G. R. (2013). The Marketers' Prismatic Palette: A Review of Color Research and Future Directions. *Psychology and Marketing*, *30*(2), 187–202. https://doi.org/10.1002/mar.20597

Lagerkvist, C. J., Okello, J., Muoki, P., Heck, S., & Prain, G. (2016). Nutrition promotion messages: The effect of information on consumer sensory expectations, experiences and emotions of vitamin A-biofortified sweet potato. *Food Quality and Preference*, *52*, 143–152. https://doi.org/10.1016/j.foodqual.2016.04.009

Lähteenmäki, L. (2013). Claiming health in food products. *Food Quality and Preference*, *27*(2), 196–201. https://doi.org/10.1016/j.foodqual.2012.03.006

Laing, S., & Masoodian, M. (2016). A study of the influence of visual imagery on graphic design ideation. *Design Studies*, *45*, 187–209. https://doi.org/10.1016/j.destud.2016.04.002

Lane, K. a., Banaji, M. R., Nosek, B. a., & Greenwald, A. G. (2007). Understanding and Using the Implicit Association Test: IV What We Know (So Far) about the Method. *Implicit Measures of Attitudes*, 59–102.

Lawless, H. T., & Heimann, H. (2010). *Sensory Evaluation of Food: Principles and Practices*. New York: Springer. https://doi.org/10.1007/978-1-4419-6488-5

Lee, W. J., Shimizu, M., Kniffin, K. M., & Wansink, B. (2013). You taste what you see: Do organic labels bias taste perceptions? *Food Quality and Preference*, *29*(1), 33–39. https://doi.org/10.1016/j.foodqual.2013.01.010

Lefebvre, S., & Orlowski, M. (2018). Can, cup, or bottle? The influence of beverage vessel on taste and willingness to pay. *International Journal of Hospitality Management*, (September 2017), 1–11. https://doi.org/10.1016/j.ijhm.2018.05.009

Leuthesser, L., Kohli, C. S., & Harich, K. R. (1995). Brand equity: the halo effect measure. *European Journal of Marketing*, *29*(4), 57–66. https://doi.org/10.1108/03090569510086657

Levitan, C. A., & Shermer, D. Z. (2014). Red Hot: The Crossmodal Effect of Color Intensity on Perceived Piquancy. *Multisensory Research*, *27*(3–4), 207–223. https://doi.org/10.1163/22134808-00002457

Lewis, C., & Walker, P. (1989). Typographic influences on reading. *British Journal of Psychology*, *80*(2), 241–257. https://doi.org/10.1111/j.2044-8295.1989.tb02317.x

Liao, L. X., Corsi, A. M., Chrysochou, P., & Lockshin, L. (2015). Emotional responses towards food packaging: A joint application of self-report and physiological measures of emotion. *Food Quality and Preference*, *42*, 48–55. https://doi.org/10.1016/j.foodqual.2015.01.009

Lindgaard, G., Fernandes, G., Dudek, C., & Brown, J. (2006). Attention web designers: You have 50 milliseconds to make a good first impression! *Behaviour & Information Technology*, *25*(2), 115–126. https://doi.org/10.1080/01449290500330448

Lockhart, H. E. (1997). A paradigm for packaging. *Packaging Technology and Science*, *10*(5), 237–252. https://doi.org/10.1002/(SICI)1099-1522(199709/10)

Loken, B. (2006). Consumer Psychology: Categorization, Inferences, Affect, and Persuasion. *Annual Review of Psychology*, *57*(1), 453–485. https://doi.org/10.1146/annurev.psych.57.102904.190136

Loken, B., Barsalou, L. W., & Joiner, C. (2008). Categorzation Theory and Research in Consumer Psychology: Category Representation and Category-Based Inference. *Handbook of Consumer Psychology*, 133–163.

Lupton, E. (2010). *Thinking with type. A critical guide for designers, writers, editors & students*. New York: Princeton Architectural Press.

Lustig, R. H., Schmidt, L. A., & Brindis, C. D. (2012). Public health: The toxic truth about sugar. *Nature*, *482*(7383), 27–29. https://doi.org/10.1038/482027a

Lynott, D., & Connell, L. (2010). Embodied conceptual combination. *Frontiers in Psychology*, *1*(NOV), 1–14. https://doi.org/10.3389/fpsyg.2010.00212

Machiels, C. J. A., & Karnal, N. (2016). See How Tasty it is? Effects of Symbolic Cues on Product Evaluation and Taste. *Food Quality and Preference*, *52*, 195–202. https://doi.org/10.1016/j.foodqual.2016.04.014

Madden, T. J., Hewett, K., & Roth, M. S. (2000). Managing Images in Different Cultures: A Cross-National Study of Color Meanings and Preferences. *Journal of International Marketing*, *8*(4), 90–107. https://doi.org/10.1509/jimk.8.4.90.19795

Madzharov, A. V., & Block, L. G. (2010). Effects of product unit image on consumption of snack foods. *Journal of Consumer Psychology*, *20*(4), 398–409. https://doi.org/10.1016/j.jcps.2010.06.007

Magnier, L., & Schoormans, J. (2015). Consumer reactions to sustainable packaging: The interplay of visual appearance, verbal claim and environmental concern. *Journal of Environmental Psychology*, *44*, 53–62. https://doi.org/10.1016/j.jenvp.2015.09.005

Magnier, L., & Schoormans, J. (2017). How Do Packaging Material, Colour and Environmental Claim Influence Package, Brand and Product Evaluations? *Packaging Technology and Science*. https://doi.org/10.1002/pts.2318

Magnier, L., Schoormans, J., & Mugge, R. (2016). Judging a product by its cover: Packaging sustainability and perceptions of quality in food products. *Food Quality and Preference*, *53*, 132–142. https://doi.org/10.1016/j.foodqual.2016.06.006

Mai, R., Symmank, C., & Seeberg-Elverfeldt, B. (2016). Light and Pale Colors in Food Packaging: When Does This Package Cue Signal Superior Healthiness or Inferior Tastiness? *Journal of Retailing*, *92*(4), 426–444. https://doi.org/10.1016/j.jretai.2016.08.002

Maynard, O. M., Munafò, M. R., & Leonards, U. (2013). Visual attention to health warnings on plain tobacco packaging in adolescent smokers and non-smokers. *Addiction*, *108*(2), 413–419. https://doi.org/10.1111/j.1360-0443.2012.04028.x

Mead, J. A., & Richerson, R. (2018). Package color saturation and food healthfulness perceptions. *Journal of Business Research*, *82*(2), 10–18. https://doi.org/10.1016/j.jbusres.2017.08.015

Messaris, P. (1994). *Visual literacy: Image, mind, and reality*. Boulder: Westview Press.

Messaris, P. (1997). *Visual persuasion: The role of images in advertising*. Thousand Oaks, CA: Sage Publications.

Mick, D. G., Burroughs, J. E., Hetzel, P., & Brannen, M. Y. (2004). Pursuing the meaning of meaning in the commercial world: An international review of marketing and consumer research founded on semiotics. *Semiotica*, *152*(c), 1–74. https://doi.org/10.1515/semi.2004.2004.152-1-4.1

Miraballes, M., Fiszman, S., Gámbaro, A., & Varela, P. (2014). Consumer perceptions of satiating and meal replacement bars, built up from cues in packaging information, health claims and nutritional claims. *Food Research International*, *64*, 456–464. https://doi.org/10.1016/j.foodres.2014.07.028

Mizutani, N., Okamoto, M., Yamaguchi, Y., Kusakabe, Y., Dan, I., & Yamanaka, T. (2010). Package images modulate flavor perception for orange juice. *Food Quality and Preference*, *21*(7), 867–872. https://doi.org/10.1016/j.foodqual.2010.05.010

Mueller, S., Lockshin, L., & Louviere, J. J. (2009). What you see may not be what you get: Asking consumers what matters may not reflect what they choose. *Marketing Letters*, *21*(4), 335–350. https://doi.org/10.1007/s11002-009-9098-x

Mumani, A., & Stone, R. (2018). State of the art of user packaging interaction (UPI). *Packaging Technology and Science*, (November 2017), 1–19. https://doi.org/10.1002/pts.2363

Munari, B. (1973/2016). *Diseño y comunicación visual: Contribución a una metodología didáctica*. Barcelona: Gustavo Gili.

Nancarrow, C., Wright, L. T., & Brace, I. (1998). Gaining competitive advantage from packaging and labelling in marketing communications. *British Food Journal*, *100*(2), 110–118. https://doi.org/10.1108/00070709810204101

Neyens, E., Aerts, G., & Smits, T. (2015). The impact of image-size manipulation and sugar content on children's cereal consumption. *Appetite*, *95*, 152–157. https://doi.org/10.1016/j.appet.2015.07.003

Nickerson, R. S. (1998). Confirmation bias: A ubiquitous phenomenon in many guises. *Review of General Psychology*, *2*(2), 175–220. https://doi.org/10.1037/1089-2680.2.2.175

Nijs, I. M. T., Muris, P., Euser, A. S., & Franken, I. H. A. (2010). Differences in attention to food and food intake between overweight/obese and normal-weight females under conditions of hunger and satiety. *Appetite*, *54*(2), 243–254. https://doi.org/10.1016/j.appet.2009.11.004

Nisbett, R. E., & Wilson, T. D. (1977). The halo effect: Evidence for unconscious alteration of judgments. *Journal of Personality and Social Psychology*, *35*(4), 250–256. https://doi.org/10.1037/0022-3514.35.4.250

North, A. C., Hargreaves, D. J., & McKendrick, J. (1997). In-store music affects product choice. *Nature*, *390*(6656), 132–132. https://doi.org/10.1038/36484

North, A. C., Hargreaves, D. J., & McKendrick, J. (1999). The influence of in-store music on wine selections. *Journal of Applied Psychology*, *84*(2), 271–276. https://doi.org/10.1037/0021-9010.84.2.271

Nosek, B. A., Hawkins, C. B., & Frazier, R. S. (2011). Implicit social cognition: from measures to mechanisms. *Trends in Cognitive Sciences*, *15*(4), 152–159. https://doi.org/10.1016/j.tics.2011.01.005

Oberfeld, D., Hecht, H., Allendorf, U., & Wickelmaier, F. (2009). Ambient lighting modifies the flavor of wine. *Journal of Sensory Studies*, *24*(6), 797–832. https://doi.org/10.1111/j.1745-459X.2009.00239.x

Oliveira-Pinto, A. V., Santos, R. M., Coutinho, R. A., Oliveira, L. M., Santos, G. B., Alho, A. T. L., … Klein, R. (2014). Sexual Dimorphism in the Human Olfactory Bulb: Females Have More Neurons and Glial Cells than Males. *PLoS ONE*, *9*(11), e111733. https://doi.org/10.1371/journal.pone.0111733

Obrist, M., Comber, R., Subramanian, S., Piqueras-Fiszman, B., Velasco, C., & Spence, C. (2014). Temporal, affective, and embodied characteristics of taste experiences. In *Proceedings of the 32nd annual ACM conference on Human factors in computing systems - CHI '14* (pp. 2853–2862). New York, New York, USA: ACM Press. https://doi.org/10.1145/2556288.2557007

Olson, J. C., & Jacoby, J. (1972). Cue utilization in the quality perception process. In M. Venkatesan (Ed.), *SV – proceedings of the third annual conference of the association for consumer research* (pp. 169–179). Chicago, IL: Association for Consumer Research. Retrieved from http://www.acrwebsite.org/volumes/11997/volumes/sv02/SV-02

Opperud, A. (2004). Semiotic Product Analysis. In D. McDonagh, P. Hekkert, J. van Erp, & D. Gyi (Eds.), *Design and Emotion* (pp. 137–141). London: Taylor and Francis.

Orth, U. R., & Malkewitz, K. (2008). Holistic Package Design and Consumer Brand Impressions. *Journal of Marketing*, *72*(3), 64–81. https://doi.org/10.1509/jmkg.72.3.64

Oswald, L. R. (2015). *Creating Value: The Theory and Practice of Marketing Semiotics Research*. New York: Oxford University Press.

Parise, C. V., & Spence, C. (2012). Assessing the associations between brand packaging and brand attributes using an indirect performance measure. *Food Quality and Preference*, *24*(1), 17–23. https://doi.org/10.1016/j.foodqual.2011.08.004

Park, C. W., Iyer, E. S., & Smith, D. C. (1989). The Effects of Situational Factors on In-Store Grocery Shopping Behavior: The Role of Store Environment and Time Available for Shopping. *Journal of Consumer Research*, *15*(4), 422. https://doi.org/10.1086/209182

Peirce, C. S. (1867-1893/1992). *The essential Peirce: Selected philosophical writings, volume 1 (1867-1893)*. (P. E. Project, Ed.). Bloomington: Indiana University Press.

Perugini, M. (2005). Predictive models of implicit and explicit attitudes. *British Journal of Social Psychology*, *44*(1), 29–45. https://doi.org/10.1348/014466604X23491

Petty, R. E., & Cacioppo, J. T. (1996). *Attitudes and persuasion: Classic and contemporary approaches*. Westview Press. Retrieved from http://psycnet.apa.org/psycinfo/1996-97904-000

Piqueras-Fiszman, B., Ares, G., & Varela, P. (2011). Semiotics and Perception : Do Labels Convey the Same Messages To Older and Younger Consumers? *Journal of Sensory Studies*, *26*(3), 197–208. https://doi.org/10.1111/j.1745-459X.2011.00336.x

Piqueras-Fiszman, B., Harrar, V., Alcaide, J., & Spence, C. (2011). Does the weight of the dish influence our perception of food? *Food Quality and Preference*, *22*(8), 753–756. https://doi.org/10.1016/j.foodqual.2011.05.009

Piqueras-Fiszman, B., Laughlin, Z., Miodownik, M., & Spence, C. (2012). Tasting spoons: Assessing how the material of a spoon affects the taste of the food. *Food Quality and Preference*, *24*(1), 24–29. https://doi.org/10.1016/j.foodqual.2011.08.005

Piqueras-Fiszman, B., & Spence, C. (2011). Crossmodal correspondences in product packaging. Assessing color-flavor correspondences for potato chips (crisps). *Appetite*, *57*(3), 753–7. https://doi.org/10.1016/j.appet.2011.07.012

Piqueras-Fiszman, B., & Spence, C. (2012). The weight of the container influences expected satiety, perceived density, and subsequent expected fullness. *Appetite*, *58*(2), 559–562. https://doi.org/10.1016/j.appet.2011.12.021

Piqueras-Fiszman, B., & Spence, C. (2015). Sensory expectations based on product-extrinsic food cues: An interdisciplinary review of the empirical evidence and theoretical accounts. *Food Quality and Preference*, *40*(PA), 165–179. https://doi.org/10.1016/j.foodqual.2014.09.013

Piqueras-Fiszman, B., Velasco, C., Salgado-Montejo, A., & Spence, C. (2013). Using combined eye tracking and word association in order to assess novel packaging solutions: A case study involving jam jars. *Food Quality and Preference*, *28*(1), 328–338. https://doi.org/10.1016/j.foodqual.2012.10.006

Piqueras-Fiszman, B., Velasco, C., & Spence, C. (2012). Exploring implicit and explicit crossmodal colour-flavour correspondences in product packaging. *Food Quality and Preference*, *25*(2), 148–155. https://doi.org/10.1016/j.foodqual.2012.02.010

Ploydanai, K., van den Puttelaar, J., van Herpen, E., & van Trijp, H. (2017). Using a Virtual Store As a Research Tool to Investigate Consumer In-store Behavior. *Journal of Visualized Experiments*, (125), 1–15. https://doi.org/10.3791/55719

Puyares, V., Ares, G., & Carrau, F. (2010). Searching a specific bottle for Tannat wine using a check-all-that apply question and conjoint analysis. *Food Quality and Preference*, *21*(7), 684–691. https://doi.org/10.1016/j.foodqual.2010.05.008

Rebollar, R., Lidón, I., Guzmán, R., Gil, I., & Martín, J. (2017). The influence of illuminance level on perception and willingness to buy during the tasting of sweetened natural yoghurt. *Food Quality and Preference*, *62*, 270–274. https://doi.org/10.1016/j.foodqual.2017.05.007

Rebollar, R., Lidón, I., Martín, J., & Puebla, M. (2015). The identification of viewing patterns of chocolate snack packages using eye-tracking techniques. *Food Quality and Preference*, *39*, 251–258. https://doi.org/10.1016/j.foodqual.2014.08.002

Reimann, M., Zaichkowsky, J., Neuhaus, C., Bender, T., & Weber, B. (2010). Aesthetic package design: A behavioral, neural, and psychological investigation. *Journal of Consumer Psychology*, *20*(4), 431–441. https://doi.org/10.1016/j.jcps.2010.06.009

Roe, B., Levy, A., & Derby, B. M. (1999). The impact of health claims on consumer search and product evaluation outcomes: Results from FDA experimental data. *Journal of Public Policy & Marketing*, *18*(1), 89–105. Retrieved from http://www.jstor.org/stable/30000511

Roininen, K., Arvola, A., & Lähteenmäki, L. (2006). Exploring consumers' perceptions of local food with two different qualitative techniques: Laddering and word association. *Food Quality and Preference*, *17*(1–2), 20–30. https://doi.org/10.1016/j.foodqual.2005.04.012

Román, S., Sánchez-Siles, L. M., & Siegrist, M. (2017). The importance of food naturalness for consumers: Results of a systematic review. *Trends in Food Science and Technology*, *67*, 44–57. https://doi.org/10.1016/j.tifs.2017.06.010

Running, C. A., & Hayes, J. E. (2016). Individual Differences in Multisensory Flavor Perception. In B. Piqueras-Fiszman & C. Spence (Eds.), *Multisensory Flavor Perception* (pp. 185–210). Woodhead Publishing. https://doi.org/10.1016/B978-0-08-100350-3.00010-9

Saito, M. (1996). Comparative studies on color preference in Japan and other asian regions, with special emphasis on the preference for white. *Color Research and Application*, *21*(1), 35–49. https://doi.org/10.1002/(SICI)1520-6378(199602)21:1<35::AID-COL4>3.0.CO;2-6

Sakai, N., & Morikawa, S. (2006). The pictures of fruits juices affect flavor perception of fruit juices. *The Japanese Association for the Study of Taste and Smell*, *13*(3), 463–466.

Schifferstein, H. N. J., Fenko, A., Desmet, P. M. A., Labbe, D., & Martin, N. (2013). Influence of package design on the dynamics of multisensory and emotional food experience. *Food Quality and Preference*, *27*(1), 18–25. https://doi.org/10.1016/j.foodqual.2012.06.003

Schifferstein, H. N. J., Howell, B. F., & Pont, S. C. (2017). Colored backgrounds affect the attractiveness of fresh produce, but not it's perceived color. *Food Quality and Preference*, *56*, 173–180. https://doi.org/10.1016/j.foodqual.2016.10.011

Schiffman, L. G., Hansen, H., & Kanuk, L. (2012). *Consumer behaviour: A European Outlook*. Harlow: Prentice Hall.

Schmitt, N. (1998). Quantifying word association responses: what is native-like? *System*, *26*(3), 389–401. http://dx.doi.org/10.1016/S0346-251X(98)00019-0

Schuldt, J. P. (2013). Does Green Mean Healthy? Nutrition Label Color Affects Perceptions of Healthfulness. *Health Communication*, *28*(8), 814–821. https://doi.org/10.1080/10410236.2012.725270

Schuldt, J. P., Muller, D., & Schwarz, N. (2012). The "Fair Trade" Effect: Health Halos From Social Ethics Claims. *Social Psychological and Personality Science*, *3*(5), 581–589. https://doi.org/10.1177/1948550611431643

Schuldt, J. P., & Schwarz, N. (2010). The "organic" path to obesity? Organic claims influence calorie judgments and exercise recommendations. *Judgment and Decision Making*, *5*(3), 144–150.

Scott, L. (1994). Images in Advertising - the Need for a Theory of Visual Rhetoric. *Journal of Consumer Research*, *21*(2), 252–273. https://doi.org/10.1086/209396

Semin, G. R., & Palma, T. A. (2014). Why the bride wears white: Grounding gender with brightness. *Journal of Consumer Psychology*, *24*(2), 217–225. https://doi.org/10.1016/j.jcps.2013.09.003

Silayoi, P., & Speece, M. (2007). The importance of packaging attributes: a conjoint analysis approach. *European Journal of Marketing*, *41*(11/12), 1495–1517. https://doi.org/10.1108/03090560710821279

Simmonds, G., & Spence, C. (2017). Thinking inside the box: How seeing products on, or through, the packaging influences consumer perceptions and purchase behaviour. *Food Quality and Preference*, *62*, 340–351. https://doi.org/10.1016/j.foodqual.2016.11.010

Simmonds, G., Woods, A. T., & Spence, C. (2017). 'Show me the Goods': Assessing the Effectiveness of Transparent Packaging vs. Product Imagery on Product Evaluation. *Food Quality and Preference*, *(In press)*. https://doi.org/10.1016/j.foodqual.2017.07.015

Singh, & Satyendra. (2006). Impact of color on marketing. *Management Decision*, *44*, 783–789. https://doi.org/10.1108/00251740610673332

Skaczkowski, G., Durkin, S., Kashima, Y., & Wakefield, M. (2016). The effect of packaging, branding and labeling on the experience of unhealthy food and drink: A review. *Appetite*. https://doi.org/10.1016/j.appet.2016.01.022

Smith, E. E., Osherson, D. N., Rips, L. J., & Keane, M. (1988). Combining prototypes: A selective modification model. *Cognitive Science*, *12*(4), 485–527. https://doi.org/10.1016/0364-0213(88)90011-0

Smith, V., Barratt, D., & Selsøe Sørensen, H. (2015). Do natural pictures mean natural tastes? Assessing visual semantics experimentally. *Cognitive Semiotics*, *8*(1), 53–86. https://doi.org/10.1515/cogsem-2015-0001

Smith, V., Møgelvang-Hansen, P., & Hyldig, G. (2010). Spin versus fair speak in food labelling: A matter of taste? *Food Quality and Preference*, *21*(8), 1016–1025. https://doi.org/10.1016/j.foodqual.2010.05.016

Solomon, M., Bamossy, G., Askegaard, S., & Hogg, M. K. (2008). *Consumer Behaviour: A European Perspective*. Harlow: Prentice Hall.

Spence, C. (2011). Mouth-Watering: The Influence Of Environmental And Cognitive Factors On Salivation And Gustatory/Flavor Perception. *Journal of Texture Studies*, *42*(2), 157–171. https://doi.org/10.1111/j.1745-4603.2011.00299.x

Spence, C. (2015a). Multisensory Flavor Perception. *Cell*, *161*(1), 24–35. https://doi.org/10.1016/j.cell.2015.03.007

Spence, C. (2015b). On the psychological impact of food colour. *Flavour*, *4*(1), 21. https://doi.org/10.1186/s13411-015-0031-3

Spence, C. (2015c). Visual contributions to taste and flavour perception. In M. J. Scotter (Ed.), *Colour Additives for Foods and Beverages* (pp. 189–210). Cambridge: Woodhead Publishing. https://doi.org/10.1016/B978-1-78242-011-8.00007-6

Spence, C. (2016). Multisensory Packaging Design: Color, Shape, Texture, Sound, and Smell. In *Integrating the Packaging and Product Experience in Food and Beverages* (pp. 1–22). https://doi.org/10.1016/B978-0-08-100356-5.00001-2

Spence, C. (2017). *Gastrophysics: The new science of eating*. London, UK: Penguin.

Spence, C. (2018a). Background colour & its impact on food perception & behaviour. *Food Quality and Preference*, *68*(December 2017), 156–166. https://doi.org/10.1016/j.foodqual.2018.02.012

Spence, C. (2018b). Multisensory Perception. In *Stevens' Handbook of Experimental Psychology and Cognitive Neuroscience* (pp. 1–56). Hoboken, NJ: John Wiley & Sons, Inc. https://doi.org/10.1002/9781119170174.epcn214

Spence, C., & Deroy, O. (2013). How automatic are crossmodal correspondences? *Consciousness and Cognition*, *22*(1), 245–260. https://doi.org/10.1016/j.concog.2012.12.006

Spence, C., Okajima, K., Cheok, A. D., Petit, O., & Michel, C. (2015). Eating with our eyes: From visual hunger to digital satiation. *Brain and Cognition*. https://doi.org/10.1016/j.bandc.2015.08.006

Spence, C., & Piqueras-Fiszman, B. (2014a). Tastes Great, But What do We Call It? The Art and Science of Food Description. In *The Perfect Meal* (pp. 71–107). Chichester, UK: John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118491003.ch3

Spence, C., & Piqueras-Fiszman, B. (2014b). *The Perfect Meal: The Multisensory Science of Food and Dining*. Chichester, UK: John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118491003

Spence, C., & Piqueras-Fiszman, B. (2016). Food Color and Its Impact on Taste/Flavor Perception. In B. Piqueras-Fiszman & C. Spence (Eds.), *Multisensory Flavor Perception* (pp. 107–132). Woodhead Publishing. https://doi.org/10.1016/B978-0-08-100350-3.00006-7

Spence, C., Smith, B., & Auvray, M. (2014). Confusing Tastes with Flavours. In D. Stokes, M. Matthen, & S. Biggs (Eds.), *Perception and Its Modalities* (pp. 247–276). Oxford, UK: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199832798.003.0011

Spence, C., Wan, X., Woods, A., Velasco, C., Deng, J., Youssef, J., & Deroy, O. (2015). On tasty colours and colourful tastes? Assessing, explaining, and utilizing crossmodal correspondences between colours and basic tastes. *Flavour*, *4*(1), 23. https://doi.org/10.1186/s13411-015-0033-1

Sperber, D., & Wilson, D. (1995). *Relevance: Communication and cognition*. Malden: Blackwell Publishing.

Spillmann, L., & Ehrenstein, W. H. (1996). From neuron to Gestalt: mechanisms of visual perception. In R. Greger & U. Windhorst (Eds.), *Comprehensive Human Physiology: From Cellular Mechanisms to Integration* (Vol. 1, pp. 861–893). Berlin, Heidelberg: Springer-Verlag.

Spinelli, S., & Niedziela, M. (2016). Emotion Measurements and Application to Product and Packaging Development. In P. Burguess (Ed.), *Integrating the Packaging and Product Experience in Food and Beverages: A Road-Map to Consumer Satisfaction* (pp. 77–119). Woodhead Publishing. https://doi.org/10.1016/B978-0-08-100356-5.00005-X

Stacy, A. W., Ames, S. L., & Grenard, J. L. (2006). Word Association Tests of Associative Memory and Implicit Processes: Theoretical and Assessment Issues. In *Handbook of Implicit Cognition and Addiction* (pp. 75–90). 2455 Teller Road, Thousand Oaks California 91320 United States: SAGE Publications, Inc. https://doi.org/10.4135/9781412976237.n6

Stasi, A., Songa, G., Mauri, M., Ciceri, A., Diotallevi, F., Nardone, G., & Russo, V. (2018). Neuromarketing empirical approaches and food choice: A systematic review. *Food Research International*, *108*(November), 650–664. https://doi.org/10.1016/j.foodres.2017.11.049

Steenis, N. D., van Herpen, E., van der Lans, I. A., Ligthart, T. N., & van Trijp, H. C. M. (2017). Consumer response to packaging design: The role of packaging materials and graphics in sustainability perceptions and product evaluations. *Journal of Cleaner Production*, *162*, 286–298. https://doi.org/10.1016/j.jclepro.2017.06.036

Sütterlin, B., & Siegrist, M. (2015). Simply adding the word "fruit" makes sugar healthier: The misleading effect of symbolic information on the perceived healthiness of food. *Appetite*, *95*, 252–261. https://doi.org/10.1016/j.appet.2015.07.011

Swientek, B. (2001). Uncanny Developments. *Beverage Industry*, *92*(12), 38–39.

Szocs, C., & Lefebvre, S. (2016). The blender effect: Physical state of food influences healthiness perceptions and consumption decisions. *Food Quality and Preference*, *54*, 152–159. https://doi.org/10.1016/j.foodqual.2016.07.009

Szocs, C., & Lefebvre, S. (2017). Spread or stacked? Vertical versus horizontal food presentation, portion size perceptions, and consumption. *Journal of Business Research*, *75*, 249–257. https://doi.org/10.1016/j.jbusres.2016.07.022

Tannenbaum, P. H., Jacobson, H. K., & Norris, E. L. (1964). An Experimental Investigation of Typeface Connotations. *Journalism Quarterly*, *41*(1), 65–73. https://doi.org/10.1177/107769906404100108

Te Vaarwerk, M. C., van Rompay, T. J. L., & Okken, V. S. (2015). Under cover and close at hand: Embodied metaphor in packaging design. *International Journal of Design*, *9*(1), 29–37.

Teige-Mocigemba, S., Klauer, K. C., & Sherman, J. W. (2010). A Practical Guide to Implicit Association Tests and Related Tasks. In B. Gawronski & B. K. Payne (Eds.), *Handbook of Implicit Social Cognition Measurement, Theory, and Applications* (pp. 117–139). New York: Guilford Press.

Tempesta, T., Giancristofaro, R. A., Corain, L., Salmaso, L., Tomasi, D., & Boatto, V. (2010). The importance of landscape in wine quality perception: An integrated approach using choice-based conjoint analysis and combination-based permutation tests. *Food Quality and Preference*, *21*(7), 827–836. https://doi.org/10.1016/j.foodqual.2010.04.007

Thomas, S., & Chambault, M. (2016). Explicit Methods to Capture Consumers' Responses to Packaging. In P. Burgess (Ed.), *Integrating the Packaging and Product Experience in Food and Beverages* (pp. 139–159). Woodhead Publishing. https://doi.org/10.1016/B978-0-08-100356-5.00007-3

Thomson, D. M. H. (2016). Sensory Branding: Using Brand, Pack, and Product Sensory Characteristics to Deliver a Compelling Brand Message. In B. Piqueras-Fiszman & C. Spence (Eds.), *Multisensory Flavor Perception* (pp. 313–336). Woodhead Publishing. https://doi.org/10.1016/B978-0-08-100350-3.00016-X

Tijssen, I., Zandstra, E. H., de Graaf, C., & Jager, G. (2017). Why a 'light' product package should not be light blue: Effects of package colour on perceived healthiness and attractiveness of sugar- and fat-reduced products. *Food Quality and Preference*, *59*, 46–58. https://doi.org/10.1016/j.foodqual.2017.01.019

Tu, Y., Yang, Z., & Ma, C. (2016). The Taste of Plate: How the Spiciness of Food is Affected by the Color of the Plate Used to Serve It. *Journal of Sensory Studies*, *31*(1), 50–60. https://doi.org/10.1111/joss.12190

Underwood, R. L. (2003). The Communicative Power of Product Packaging: Creating Brand Identity via Lived and Mediated Experience. *Journal of Marketing Theory and Practice*, *11*(1), 62–76. https://doi.org/10.1080/10696679.2003.11501933

Underwood, R. L., & Klein, N. M. (2002). Packaging as brand communication: Effects of product pictures on consumer responses to the package and brand. *Journal of Marketing Theory and Practice*, *10*(4), 58–68. https://doi.org/10.1080/10696679.2002.11501926

Underwood, R. L., & Ozanne, J. L. (1998). Is your package an effective communicator? A normative framework for increasing the communicative competence of packaging. *Journal of Marketing Communications*, *4*, 207–220. https://doi.org/10.1080/135272698345762

van Herpen, E., Immink, V., & van den Puttelaar, J. (2016). Organics unpacked: The influence of packaging on the choice for organic fruits and vegetables. *Food Quality and Preference*, *53*, 90–96. https://doi.org/10.1016/j.foodqual.2016.05.011

van Herpen, E., & Trijp, H. C. M. va. (2011). Front-of-pack nutrition labels. Their effect on attention and choices when consumers have varying goals and time constraints. *Appetite*, *57*(1), 148–160. https://doi.org/10.1016/j.appet.2011.04.011

van Jaarsveld, H. J., Coolen, R., & Schreuder, R. (1994). The role of analogy in the interpretation of novel compounds. *Journal of Psycholinguistic Research*, *23*(2), 111–137. https://doi.org/10.1007/BF02143919

van Ooijen, I., Fransen, M. L., Verlegh, P. W. J., & Smit, E. G. (2017). Signalling product healthiness through symbolic package cues: Effects of package shape and goal congruence on consumer behaviour. *Appetite*, *109*, 73–82. https://doi.org/10.1016/j.appet.2016.11.021

Van Rompay, T. J. L., & Pruyn, A. T. H. (2011). When visual product features speak the same language: Effects of shape-typeface congruence on brand perception and price expectations. *Journal of Product Innovation Management*, *28*(4), 599–610. https://doi.org/10.1111/j.1540-5885.2011.00828.x

Velasco, C., Salgado-Montejo, A., Marmolejo-Ramos, F., & Spence, C. (2014). Predictive packaging design: Tasting shapes, typefaces, names, and sounds. *Food Quality and Preference*, *34*, 88–95. https://doi.org/10.1016/j.foodqual.2013.12.005

Velasco, C., Woods, A. T., & Hyndman, S. (2015). The Taste of Typeface. *I-Perception*, *6*(4), 1–11. https://doi.org/10.1177/2041669515593040

Velasco, C., Woods, A. T., Petit, O., Cheok, A. D., & Spence, C. (2016). Crossmodal correspondences between taste and shape, and their implications for product packaging: A review. *Food Quality and Preference*, *52*(4), 17–26. https://doi.org/10.1016/j.foodqual.2016.03.005

Velasco, C., Woods, A. T., & Spence, C. (2015). Evaluating the orientation of design elements in product packaging using an online orientation task. *Food Quality and Preference*, *46*, 151–159. https://doi.org/10.1016/j.foodqual.2015.07.018

Venter, K., van der Merwe, D., de Beer, H., Kempen, E., & Bosman, M. (2011). Consumers' perceptions of food packaging: an exploratory investigation in Potchefstroom, South Africa. *International Journal of Consumer Studies*, *35*(3), 273–281. https://doi.org/10.1111/j.1470-6431.2010.00936.x

Versluis, I., Papies, E. K., & Marchiori, D. (2015). Preventing the pack size effect: exploring the effectiveness of pictorial and non-pictorial serving size recommendations. *Appetite*, *87*, 116–26. https://doi.org/10.1016/j.appet.2014.12.097

Walters, A., & Long, M. (2012). The effect of food label cues on perceptions of quality and purchase intentions among high-involvement consumers with varying levels of nutrition knowledge. *Journal of Nutrition Education and Behavior*, 44(4), 350–4. https://doi.org/10.1016/j.jneb.2011.08.008

Wang, Q. (Janice), Keller, S., & Spence, C. (2017). Sounds spicy: Enhancing the evaluation of piquancy by means of a customised crossmodally congruent soundtrack. *Food Quality and Preference, 58*, 1–9. https://doi.org/10.1016/j.foodqual.2016.12.014

Wansink, B. (2004). Environmental Factors That Increase the Food Intake and Consumption Volume of Unknowing Consumers. *Annual Review of Nutrition*, *24*(1), 455–479. https://doi.org/10.1146/annurev.nutr.24.012003.132140

Wei, S. T., Ou, L. C., Luo, M. R., & Hutchings, J. B. (2014). Package design: Colour harmony and consumer expectations. *International Journal of Design*, *8*(1), 109–126.

Wentura, D., & Degner, J. (2010). A practical guide to sequential priming and related tasks. In B. Gawronski & B. K. Payne (Eds.), *Handbook of implicit social cognition: measurement, theory and applications* (p. 594). New York: Guilford Press. Retrieved from http://dare.uva.nl/search?metis.record.id=333027

Westerman, S. J., Sutherland, E. J., Gardner, P. H., Baig, N., Critchley, C., Hickey, C., ... Zervos, Z. (2013). The design of consumer packaging: Effects of manipulations of shape, orientation, and alignment of graphical forms on consumers' assessments. *Food Quality and Preference, 27*(1), 8–17. https://doi.org/10.1016/j.foodqual.2012.05.007

Wilcock, A., Pun, M., Khanona, J., & Aung, M. (2004). Consumer attitudes, knowledge and behaviour: A review of food safety issues. *Trends in Food Science and Technology*, *15*(2), 56–66. https://doi.org/10.1016/j.tifs.2003.08.004

Woods, A. T., Lloyd, D. M., Kuenzel, J., Poliakoff, E., Dijksterhuis, G. B., & Thomas, A. (2011). Expected taste intensity affects response to sweet drinks in primary taste cortex. *NeuroReport*, *22*(8), 365–369. https://doi.org/10.1097/WNR.0b013e3283469581

Woods, A. T., Poliakoff, E., Lloyd, D. M., Dijksterhuis, G. B., & Thomas, A. (2010). Flavor expectation: The effect of assuming homogeneity on drink perception. *Chemosensory Perception*, *3*(3–4), 174–181. https://doi.org/10.1007/s12078-010-9080-2

Woods, A. T., Velasco, C., Levitan, C. A., Wan, X., & Spence, C. (2015). Conducting perception research over the internet: a tutorial review. *PeerJ*, *3*, e1058. https://doi.org/10.7717/peerj.1058

Yang, C.-M., & Hsu, T.-F. (2015). Applying Semiotic Theories to Graphic Design Education: An Empirical Study on Poster Design Teaching. *International Education Studies*, *8*(12), 117. https://doi.org/10.5539/ies.v8n12p117

Yang, F. L., Cho, S., & Seo, H. S. (2016). Effects of Light Color on Consumers' Acceptability and Willingness to Eat Apples and Bell Peppers. *Journal of Sensory Studies*, *31*(1), 3–11. https://doi.org/10.1111/joss.12183

Yeomans, M. R., Chambers, L., Blumenthal, H., & Blake, A. (2008). The role of expectancy in sensory and hedonic evaluation: The case of smoked salmon ice-cream. *Food Quality and Preference*, *19*(6), 565–573. https://doi.org/10.1016/j.foodqual.2008.02.009

Zampini, M., & Spence, C. (2004). The Role of Auditory Cues in Modulating the Perceived Crispness and Staleness of Potato Chips. *Journal of Sensory Studies*, *19*(5), 347–363. https://doi.org/10.1111/j.1745-459x.2004.080403.x

7. APPENDICES

7.1. Publications' impact factors

- **Study 1** p. 57
  The paper "How material, visual and verbal cues on packaging influence consumer expectations and willingness to buy: The case of crisps (potato chips) in Spain" was published in the journal *Food Research International*, *99*, 239–246 (2017). https://doi.org/10.1016/j.foodres.2017.05.024
  Food Research International's **JCR Journal Impact Factor** in 2017 was **3.520**, placing it in position **14** of **133** (quartile **Q1**) of the Category **Food Science & Technology**.

- **Study 2** p. 67
  The paper "Images used to convey that a natural yogurt is sweetened influence consumer expectations and willingness to buy" was submitted for publication to the *Journal of Dairy Science* in 2018.
  Journal of Diary Science's **JCR Journal Impact Factor** in 2017 (the latest available data) was **2.749**, placing it in position **4** of **60** (quartile **Q1**) of the Category **Agriculture, Dairy and Animal Science**.

- **Study 3** p. 109
  The paper "The influence the serving suggestion displayed on soft cheese packaging has on consumer expectations and willingness to buy" was published in the journal *Food Quality and Preference*, *52*, 188–194 (2016). https://doi.org/10.1016/j.foodqual.2016.04.015
  Food Quality and Preference's **JCR Journal Impact Factor** in 2016 was **3.199**, placing it in position **16** of **130** (quartile **Q1**) of the Category **Food Science & Technology**.

- **Study 4** p. 119
  The paper "The influence the image of the product shown on food packaging labels has on product perception during tasting: Effects and gender differences" was accepted for publication in the journal *Packaging Technology and Science* in 2018 and is currently in press. https://doi.org/10.1002/pts.2407
  Packaging Technology and Science's **JCR Journal Impact Factor** in 2017 (the latest available data) was **1.808**, placing it in position **65** of **133** (quartile **Q2**) of the Category **Food Science & Technology**.

- **Study 5** p. 131
  The paper "What do you mean by hot? Assessing the associations raised by the visual depiction of an image of fire on food packaging" was published in the journal *Food Quality and Preference*, *71*, 384–394 (2019). https://doi.org/10.1016/j.foodqual.2018.08.015
  Food Quality and Preference's **JCR Journal Impact Factor** in 2017 (the latest available data) was **3.652**, placing it in position **13** of **133** (quartile **Q1**) of the Category **Food Science & Technology**.

- **Study 6** p. 145
  The paper "Hot or not? Conveying sensory information on food packaging through the spiciness-shape correspondence" was published in the journal *Food Quality and Preference*, *71*, 197–208 (2019). https://doi.org/10.1016/j.foodqual.2018.07.009
  Food Quality and Preference's **JCR Journal Impact Factor** in 2017 (the latest available data) was **3.652**, placing it in position **13** of **133** (quartile **Q1**) of the Category **Food Science & Technology**.

7.2. Co-authorship contribution

- **Study 1** p. 57
  Rebollar, R., **Gil, I.**, Lidón, I., Martín, J., Fernández, M. J., & Rivera, S. (2017). How material, visual and verbal cues on packaging influence consumer expectations and willingness to buy: The case of crisps (potato chips) in Spain. *Food Research International*, *99*, 239–246. https://doi.org/10.1016/j.foodres.2017.05.024
  - Literature review and stablishment of a theoretical framework.
  - Statistical analysis of the data.
  - Discussion of the results and framing on the existant literature.
  - Writing of the paper.
  - Re-writing and improving the paper following reviewers' comments.

- **Study 2** p. 67
  Rebollar, R., Lidón, I., **Gil-Pérez, I.**, & Martín, J. (2018). Images used to convey that a natural yogurt is sweetened influence consumer expectations and willingness to buy. *Manuscript submitted for publication to the Journal of Dairy Science*.
  - Literature review and stablishment of a theoretical framework.
  - Discussion of the results and framing on the existant literature.
  - Writing of the paper together with other co-authors.

- **Study 3** p. 109
  Rebollar, R., Lidón, I., **Gil, I.**, Martín, J., Fernández, M. J., & Riveres, C. E. (2016). The influence the serving suggestion displayed on soft cheese packaging has on consumer expectations and willingness to buy. *Food Quality and Preference*, *52*, 188–194. https://doi.org/10.1016/j.foodqual.2016.04.015
  - Literature review and stablishment of a theoretical framework.
  - Statistical analysis of the data.
  - Discussion of the results and framing on the existant literature.
  - Writing of the paper.
  - Re-writing and improving the paper following reviewers' comments.

- **Study 4** p. 119
  Lidón, I., Rebollar, R., **Gil-Pérez, I.**, Martín, J., & Vicente-Villardón, J. L. (in press). The influence the image of the product shown on food packaging labels has on product perception during tasting: Effects and gender differences. *Packaging Technology and Science*. https://doi.org/10.1002/pts.2407
  - Ideation of the study.
  - Literature review and stablishment of a theoretical framework.
  - Design of the stimuli.
  - Design of the experimental procedure.
  - Conduction of the experiment and gathering of the data.
  - Statistical analysis of the data.
  - Discussion of the results and framing on the existant literature.
  - Writing of the paper.
  - Re-writing and improving the paper following reviewers' comments.

- **Study 5** p. 131
  Gil-Pérez, I., Rebollar, R., Lidón, I., Piqueras-Fiszman, B., & van Trijp, H. C. M. (2019). What do you mean by hot? Assessing the associations raised by the visual depiction of an image of fire on food packaging. *Food Quality and Preference*, *71*, 384–394. https://doi.org/10.1016/j.foodqual.2018.08.015
  - Ideation of the study.
  - Literature review and stablishment of a theoretical framework.
  - Design of the stimuli.
  - Design of the experimental procedure.
  - Conduction of the experiment and gathering of the data.
  - Statistical analysis of the data.
  - Discussion of the results and framing on the existant literature.
  - Writing of the paper.
  - Re-writing and improving the paper following reviewers' comments.

- **Study 6** p. 145
  Gil-Pérez, I., Rebollar, R., Lidón, I., Martín, J., van Trijp, H. C. M., & Piqueras-Fiszman, B. (2019). Hot or not? Conveying sensory information on food packaging through the spiciness-shape correspondence. *Food Quality and Preference*, *71*, 197–208. https://doi.org/10.1016/j.foodqual.2018.07.009
  - Ideation of the study.
  - Literature review and stablishment of a theoretical framework.
  - Design of the stimuli.
  - Design of the experimental procedure.
  - Conduction of the experiment and gathering of the data.
  - Statistical analysis of the data.
  - Discussion of the results and framing on the existant literature.
  - Writing of the paper.
  - Re-writing and improving the paper following reviewers' comments.

7.3. Related research activities

Other research articles

- Rebollar, R., Lidón, I., Guzmán, R., **Gil, I.**, & Martín, J. (2017). The influence of illuminance level on perception and willingness to buy during the tasting of sweetened natural yoghurt. *Food Quality and Preference*, *62*, 270–274. https://doi.org/10.1016/j.foodqual.2017.05.007
  Food Quality and Preference's **JCR Journal Impact Factor** in 2017 was **3.652**, placing it in position **13** of **133** (quartile **Q1**) of the Category **Food Science & Technology**.

Book chapters

- **Gil, I.**, Rebollar, R., Lidón, I., & Martín, J. (2017). Study on the Influence of Fresh White Cheese Packaging Design Variables on Users' Perception. In J. Ayuso Muñoz, J. Yagüe Blanco, & S. Capuz-Rizo (Eds.), *Project Management and Engineering Research. Lecture Notes in Management and Industrial Engineering* (pp. 37–49). Cham: Springer. https://doi.org/10.1007/978-3-319-51859-6_3

Conference proceedings

- **Gil-Pérez, I.**, Lidón, I., Rebollar, R., & Martín, J. (2015). Study of the Influence of White Cheese Packaging Design Variables in User's Perception. In *19th International Congress on Project Management and Engineering*. Granada (Spain).

- **Gil-Pérez, I.**, Lidón, I., Rebollar, R., & Martín, J. (2016). Influence of the Images Displayed in the Packaging in Consumers' Sensory Perception. In *20th International Congress on Project Management and Engineering*. Cartagena (Spain).

- **Gil-Pérez, I.**, Lidón, I., Rebollar, R., Minguez, J., & Horna, E. (2017). The explicit and implicit response of the consumer to the images displayed in a food packaging: an exploratory study. In *21th International Congress on Project Management and Engineering*. Cádiz (Spain).

- Fernández-Gómez, M. J., Martín-Vallejo, J., Rebollar, R., Lidón, I., **Gil, I.**, & Vicente-Villardón, J. L. (2017). The MANOVA BIPLOT as tool to analyze the influence of the variety of Apple pictured on the label of a jar of Apple sauce and the gender of consumers on perception during tasting. In *XVI Spanish Biometric Conference - CEB 2017*. Sevilla (Spain).

- **Gil-Pérez, I.**, Rebollar, R., & Lidón, I. (2018). Effects of the use of pictorial elements in a food packaging in the process of categorization and generation of expectations. In *22th International Congress on Project Management and Engineering*. Madrid (Spain).

- **Gil-Pérez, I.**, Lidón, I., Rebollar, R., & Piqueras-Fiszman, B. (2018). Crossmodal associations between flavours and shapes can be used to set up consumer expectations. Poster presented in *Eurosense 2018 - Eight European Conference on Sensory and Consumer Research*. Verona (Italy).

- **Gil-Pérez, I.**, Rebollar, R., & Lidón, I. (2018). Implying motion in a food package influences perception of level of processing and hedonic response during tasting. Poster presented in *Eurosense 2018 - Eight European Conference on Sensory and Consumer Research*. Verona (Italy).

Across six research studies, this thesis studies how manipulating the subject shown on packaging imagery influences consumer expectations, perception, and response towards the product, and investigates how consumers infer meaning from ambiguous images depicted on food packaging.

The results show that both manipulating what is depicted on the image and the way it is depicted influence consumer expectations and response, since the attributes of the products displayed on the packaging tend to influence the evaluation of the product contained within. In addition, the results demonstrate that the congruence between the image's possible meanings and the product's potential attributes plays a key role in how the image is interpreted, and that that interpretation can be modulated by manipulating the image's shape.

Overall, these findings contribute to research on design, semiotics, sensory science, and consumer psychology, and thus are discussed under an interdisciplinary approach.

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