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Conveying information through food packaging: A literature review comparing legislation with consumer perception

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ABSTRACT

Although governments have implemented regulations to inform consumers on important product properties and protect consumers from deceptive information, empirical research on how consumers perceive, interpret and experience food packages have shown frequently that consumers may be misled by how information is presented and packages are designed. While communication in some domains is strictly regulated (health), claims in other domains are largely free (nature) and do not require substantiation. Subtleties in wording, image use and image style may affect the impressions consumers form. To support consumer decision making, legislators should not only provide rules and regulations that are formally correct, but also consider the effects a message and the way it is communicated (e.g., content, typeface, size, use of images, stylistic features) may have on buyers. While it may be unclear how best to support desirable behaviours, companies that take social responsibility can build on our work to develop their strategy.

1. Introduction

Product packaging design could play an essential role in changing food-related behaviour, because packaging plays an influential role when consumers make their food purchases. For instance, the packaging shape and colour play an important role on retail shelves, because consumers who move down long store aisles first see category facings from a distance and at an angle, and start processing the larger visual elements well before they can process finer details or read text (Garber, Hyatt, & Boya, 2008). The packaging design helps to identify the product category, it provides information about the producer, brand, origin, quantity, the ingredients from which it was made, product properties such as nutritional value and vitamin content, and instructions for preparation and consumption. In addition, packaging images and labels can communicate messages related to the product's health and environmental aspects. However, some studies have indicated that the majority of environmental packaging information that companies provide can be classified as inaccurate (Polonsky et al., 1998).

Two of the major challenges facing the world in the food realm relate to the long-term effects of food consumption on people's health and their living environment (e.g., FAO & WHO, 2019; Schifferstein, 2020). An increasing number of nutrition and public health professionals suggest that future dietary guidelines should not only focus on people's health, but should also include insights from environmental sciences to reduce the impact of food production on the environment (Friel, Barosh, & Lawrence, 2014; James, Friel, Lawrence, Hoek, & Pearson, 2018; Lorenz & Langen, 2018; Mertens, Van'T Veer, Hiddink, Steijns, & Kuijsten, 2017), even though the two targets may be hard to achieve simultaneously (van de Kamp et al., 2018).

Although consumers may state that they find aspects like "healthiness" and "environmental friendliness" important for their purchase of food products, their acclaimed interest does not necessarily translate into their purchasing and consumption behaviour (Hoek, Pearson, James, Lawrence, & Friel, 2017a; Mueller, Lockshin, & Louviere, 2010; van Dam & van Trijp, 2013). When consumers select products in a store for purchase or at home for immediate consumption, their behaviour may be determined to a large extent by its price and their momentary desires for attractive, tasty, delicious food. Hence, their short-term cravings may interfere with their long-term goals to stay healthy and contribute to a clean environment. Therefore, we try to determine how packaging designers and copywriters can assist people in making healthy and environment-friendly choices among products available in the supermarkets.

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Until recently, "healthy" and "environment-friendly" were rarely considered together in terms of public health campaigns, in product marketing campaigns and in research into the effectiveness of these interventions. Nonetheless, consumers can connect them as they can both be considered as part of "doing good" through food. In addition, similar tools are used in communicating these benefits through product packaging design, such as specialised front-of-pack logos (providing an assessment or sign of approval), verbal claims, images, general packaging features, like colour, shape, and material, most of which are connected to the defined brand image and branding guidelines. Hence, we consider both aspects simultaneously in this paper and we explore the possibilities of related, adjacent concepts in our search for ways to communicate these aspects in a more effective and truthful way through packaging design.

In this paper we focus on the use of voluntary verbal claims, images and general packaging features, as these will be most relevant as instruments that can be used creatively by packaging designers. For each of these three categories, we first discuss legal aspects: what are the rules and regulations regarding the ways in which each of these instruments can be used in order to support a healthy or environment-friendly message? A special topic here concerns the use of specialised front-of-pack logos, such as Nutri-Score (Julia, Etilé, & Hercberg, 2018). They typically require a specifically (privately) regulated application procedure, which is not under the designer's line of influence. In this paper, we only briefly address the legal aspects of such logos. Subsequently, we discuss how verbal claims, images and general packaging features in different contexts are perceived by consumers and how effective they are in moving consumer behaviour in a healthier or environment-friendlier direction. An overview of the different topics discussed is presented in Fig. 1. We will end with a discussion of ethical dilemmas related to communicating the actual origin and constitution of products versus communicating aspects that are effective in changing people's behaviour in a specific direction.

2. EU legislation on claims

Within the EU, the Food Information to Consumers (FIC) Regulation (Regulation No 1169/2011) establishes the general principles, requirements and responsibilities governing food information, and in particular food labelling. This regulation sets out a list of mandatory essentials that are required to be provided to the consumer for the labelling of prepacked foods. These include the name of the food; the list of ingredients; any ingredient potentially causing allergies or intolerances; the quantity of certain ingredients or categories of ingredients; the net quantity of the food; the date of minimum durability ("best before" or "use by" date); any special storage or usage conditions; the name and address of the food business operator; the country of origin or place of provenance; and a nutrition declaration providing the energy value and the amounts of fat, saturated fat, carbohydrate, sugars, protein and salt of the food. All nutrition information must be expressed per 100 g or per 100 ml. Additional mandatory specifics may apply for specific types or categories of foods, such as dietary supplements or foods for special consumer groups (EU, 2011).

Next to describing what information is mandatory, the FIC Regulation also stipulates in Article 36 that voluntarily provided information shall not mislead consumers and, where appropriate, such information shall be based on relevant scientific data. However, in many cases it is questionable what exactly is misleading and what is not. Therefore, starting out from the general principle in food law that consumers should be protected from misleading and unsafe foods, more specific regulations have been derived. Those relevant to voluntary health and environment-related information are specified below.

2.1. Health and nutrition

The use of claims that suggest that foods contain healthy ingredients or that these ingredients elicit specific health effects, are strictly regulated in many countries (de Boer & Bast, 2015; Domínguez Díaz, Fernández-Ruiz, & Cámara, 2020). Within the EU, health claims are regulated by the Nutrition and Health Claim Regulation (NHCR), which deals with all kinds of statements that a food has particular beneficial characteristics based on its nutritional content and that are voluntarily put on the label (EC, 2006; EU, 2011). This relates to nutrition and health messages in any form, including graphic representation stating,

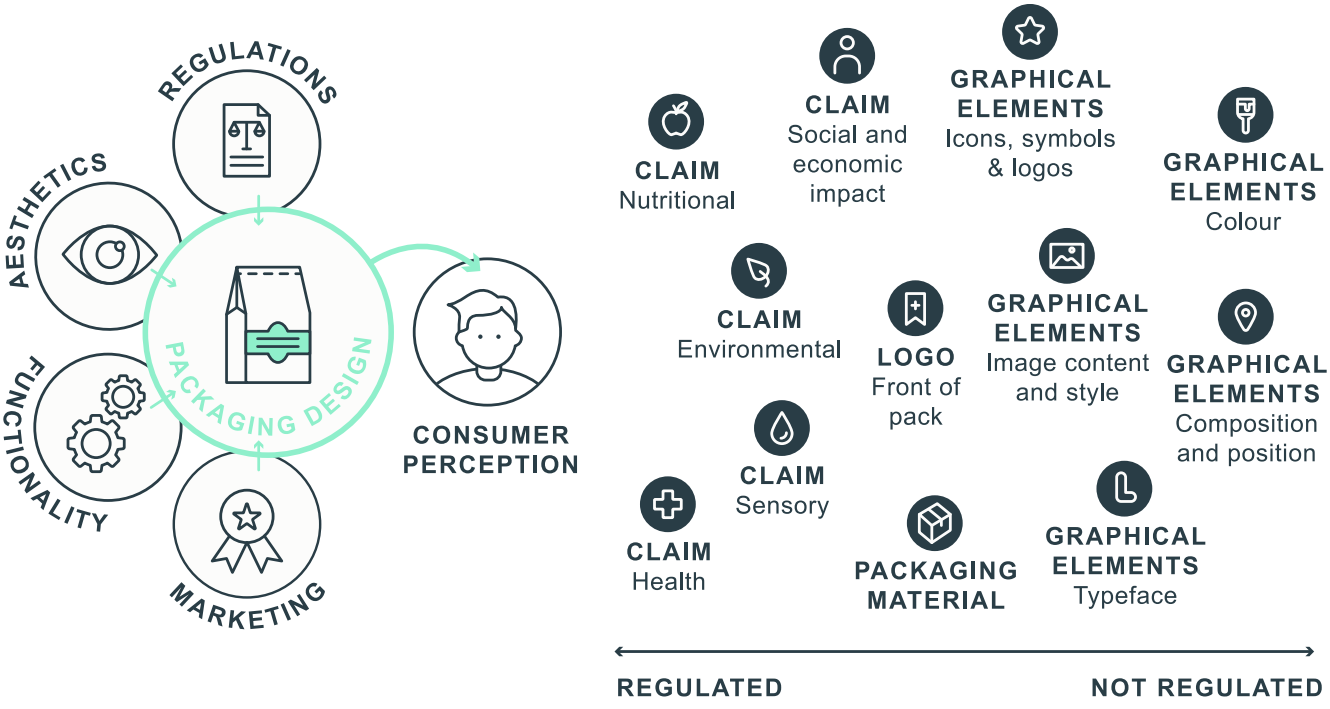

Fig. 1. Graphical representation of factors that affect consumer perception of food packages (left) and the approximate degree to which different packaging elements are regulated (right).

suggesting or implying that the food has such characteristics (EC, 2006). The regulation requires the information on the food label to be based on scientific evidence, to prevent consumers from being misled by unclear or incorrect information and false claims (Hoad, 2011; Moors, 2012). The use of a health claim is allowed or refused by the European Commission, after consulting the expert opinion of the European Food Safety Authority (EFSA) on the submitted claim (de Boer, Vos, & Bast, 2014; EFSA Panel on Dietetic Products, Nutrition and Allergies, 2021). All authorised health claims that are based on publicly available scientific evidence are described in the positive list of claims, in the Annex of Regulation (EU) No 432/2012. An overview of all authorised health claims (including claims that are based on proprietary data) can be found at https://ec.europa.eu/food/safety/labelling_nutrition/claims/register/public/?event=register.home.

The NHCR not just regulates claims relating one food ingredient to a health effect (health claims), it also regulates the use of nutrition claims within the EU. These claims refer to the quantity of a particular nutrient that is present in the product. This involves both content and comparative labels such as "rich in protein", "light", or "low in sodium". These nutrition claims can also refer to the absence of certain ingredients (e.g., fat-free) or it can claim that a product contains reduced levels of certain nutrients. For some food ingredient claims, such as claims concerning the absence or reduced quantities of gluten, separate legislation (Regulation (EU) 828/2014) describes the requirements for when these claims can be made. Most absence claims are not specifically regulated in a European context, but fall under the legislative measures taken by individual member states. Even though negative claims should be based on scientific evidence and not be misleading, it is questionable whether these requirements are fulfilled (Carreño & Vergano, 2014). EU member states differ in how strictly they interpret regulations when it comes to products that are naturally low in specific nutrients or ingredients. Over the last few years, member states' guidance and interpretations have shown that obvious claims (such as claims that certain vegetables contain no fat or that olive oil does not contain palm oil) cannot be used (Carreño & Vergano, 2015).

2.2. Environment and nature

As regards the use of environmental claims, the use of terms like organic, biological, and ecological is strictly regulated. For this case, the European Commission has established a formal regulation (Council Regulation (EC) 834/2007) that clearly describes the standards for labelling, production methods and inspections. From January 2021, this Regulation is succeeded by Regulation (EU) 2018/848, which has been updated to meet the high expectations that consumers have of organic production and clarifies the current legislative procedures. Following from this regulation, the official term "organic" and the related logo can only be used on certified products. Within EU member states, competent authorities organise certification and inspection of organic production. Organic production involves an integrated farm management system, which aims to contribute to biodiversity, preservation of natural resources, animal welfare and high-quality food. The principles emphasise the need for prevention, which obliges organic producers to adopt certain husbandry practices, rather than using external inputs, such as pesticides and fertilisers. Livestock is not treated preventively with medication to avoid diseases (EC, 2007; Sanders, 2013). Therefore, organic end products are less likely to contain residues of these chemicals (Baker, Benbrook, Groth, & Benbrook, 2002).

Other voluntary product labels or information are also not allowed to provide false information to consumers. Misleading advertisement is dealt with on EU level by the Directive on Unfair Commercial Practices (Directive 2005/29/EC) and for business-to-business relations by the Directive on Misleading and Comparative Advertising (Directive 2006/114/EC). However, since there are no strict rules for using claims such as "natural" (as separate claim), "100% pure juice", or "contributes to biodiversity", the evidence producers need to provide to support these claims is less strict. In addition, using imagery that suggests a positive contribution to the environment is not explicitly prohibited, even in cases where such a claim would not be supported by any evidence.

In the case of "natural", there is no certification procedure to determine whether a food product is "natural" or not in the US nor the EU. The technical criteria for food ingredients to be considered as natural for use by the food and beverage industry are defined in ISO/TS-norm 19657:2017, but this norm does not refer to food labelling issues. The USDA definition of "natural" as defined for meat products provides some insights into the conceptual understanding of the term: a product is natural when it does not contain artificial ingredients or added colours and is only minimally processed (USDA/FSIS, 2020). Such a statement should be accompanied by an explanation as to why this term is used, for example describing that it does not contain hormones or antibiotics. However, with no certification or standardised label for such products, the use of the term is not specifically regulated, and the definition is not considered a legal definition.

In the EU, the term "natural" is also not regulated as a general term for food products. CMO regulations describe natural ways of production and natural processes, but do not define what a natural product is. The use of the term "natural" is only defined in three specific instances: for natural mineral waters (following Directive 2009/54/EC), where "natural mineral waters" are defined (in Annex I) as "microbiologically wholesome water […], originating in an underground water table or deposit and emerging from a spring tapped at one or more natural or bore exits." Second, flavourings (Regulation (EC) 1334/2008) can be considered "natural", but only when (Article 3(c)) the flavouring substance is naturally present (in material from vegetable, animal or microbiological origin) and has been identified in nature. When using the term "natural" for flavourings, additional requirements are described in Article 16 that stipulates, for example, that when "natural" is used on a food product or when the term refers to a specific source at least 95% of the flavouring must be from that specific source (Art 16(4)). Third, the term "natural" can be used in combination with nutrition claims (Regulation (EC) 1924/2006), but only when a food naturally meets the specific conditions for such claims, as in the case with certain fish being a natural source of omega-3 fatty acids.

The UK Food Standards Agency issued guidance that describes what criteria should be fulfilled for "natural" to be used on products. This guidance (last revised in 2008) recommends that "natural" means that the ingredients of a product are "produced by nature, not the work of man or interfered with by man". Therefore, using "natural" on food products that contain chemicals "to change their composition or comprise the products of new technologies" would be considered misleading (Food Standards Agency, 2002). The Advertising Standards Authority follows this relatively strict interpretation and has upheld complaints against organizations who claimed that their products were natural while containing additives (such as Pret a Manger in 2016) (Advertising Standards Authority, 2018).

2.3. Other claims of interest

In order to make products seem more attractive, producers may also promote their product with sensory claims, such as "tasty", "delicious", and "creamy". These sensory or hedonic claims are not specifically regulated by EU legislation. The first steps towards further defining scientific requirements for sensory claim substantiation on foods have been made by the International Organization for Standardization, launching the standard ISO 20784:2021 for sensory claim substantiation on consumer goods in April 2021 (Green, 2021; ISO, 2021). Using the claim "fresh" is also currently not strictly regulated in most countries, although the hygiene rules in EC Directive 853/2004 provide some specifications for fresh fish and fresh meat products. In Europe only in Denmark and the UK specific guidance has been issued for the use of the term "fresh".

To support sustainable practices, consumers may not only consider

the environmental impact of food products, but also social and economic impact (Basiago, 1998; Pullman, Maloni, & Carter, 2009), including aspects like "small-scale production", "local production", "supports local farmers", "supports the local community" or "slave-free production". All these aspects are currently not regulated, even though some sustainable practices may be certified by third parties, such as non-governmental organisations (e.g., fair trade). Based on the recently published Farm to Fork Strategy of the European Commission (EC, 2020a), legislative proposals to deal with sustainability claims are expected in the upcoming years.

2.4. Front of pack logos

Council Regulation (EC) 834/2007 not only defines the term "organic", but it also regulates the use of a specific logo that may be used on organic products. Apart from this specific case in the realm of environment and nature, there is a proliferation of voluntary private standards and certification schemes that address social, environmental and economic sustainability, either separately or collectively. To use a front-of-pack logo, the product will have to meet specific criteria defined by the organisation that supports the logo. Food business operators improve their sustainability practices in order to adhere to these private standards and certification schemes, which enables them to use the specified logos and share their accomplishments with consumers (Lambin & Thorlakson, 2018).

Most rules regarding the use of front-of-pack logos are laid down in private law, as their requirements concern specific purposes that are not regulated by public law. However, exceptions may occur if the use of a logo can be interpreted as a nutrition or health claim. For instance, the Nutri-Score nutrition labelling scheme (Julia et al., 2018) is considered voluntary information that can help consumers understand the nutritional value of products. When this logo is green and communicates a positive message, it also fulfils the legal definition of a "nutrition claim" and thus should be based on and substantiated by generally accepted scientific evidence according to Regulation (EC) No 1924/2006 (Claims Regulation) (see EC, 2020b). To ensure that voluntary information that falls within the scope of the claims regulation is based on scientific evidence and to align the various activities related to front-of-pack labelling undertaken in different member states, the European Commission will prepare the introduction of harmonised, mandatory front-of-pack nutrition labelling within the EU by the end of 2022 (EC, 2020a).

3. Consumer perception

Although legislation may specify the rules that producers need to meet if they want to offer their food products to consumers, consumers may not perceive the products in the way that legislators or food companies intended. Therefore, it is important to investigate how consumers interpret the various sources of information on product packages. As regards consumer perception of food packaging, mainly the effects of verbal claims have been studied, whereas little attention has yet been given to the effects of images and other stylistic elements, like typefaces and background colours.

3.1. Verbal claims

First of all, we will address the extent to which different types of claims are used on food packages. Duran, Ricardo, Mais, Martins, and Taillie (2019) investigated the prevalence of different types of verbal labels on food packages in Brazil. They found that on average 41.2% of the assessed products presented claims. In some product categories claims were present in more than 80% of the products, such as breakfast cereals and granola bars (93.7%), fruit juices and nectars (92.5%), and fruit-flavoured drinks (84.1%). In a study in Singapore Lwin, Vijayakumar, and Chao (2015) found that 56.4% of the food packages contained non-nutrient claims (like "natural" and "no preservatives"), 42.3% contained nutrient content claims (like "high in fibre"), while only a very small number displayed nutrient function (4.4%) or health claims (0.3%). In a study in five European countries (the UK, the Netherlands, Germany, Slovenia and Spain), at least one health or nutrition claim was identified for 26% of all pre-packaged foods and drinks sampled (Hieke et al., 2016). All these studies suggest that verbal claims are quite common on many food products.

Lwin et al. (2015) noted that many products that contain substantial levels of critical substances (fat, sugar, salt) also contain claims suggesting a positive health effect. In some cases, even warning signs on packages were accompanied by nutrition claims for the same nutrient, hence undermining the efficacy of the warning sign. Luckily, the presence of nutrition fact panels and front-of-pack nutrition labels can reduce the cognitive biases created by health claims and can shift consumer evaluations and purchase intentions from less-healthy to more-healthy foods. Unfortunately, in everyday life consumers seldomly pay attention to the nutrition fact panel, although front-of-pack labels, which are more salient on the front of food packages, may have a stronger effect on counteracting the cognitive biases created by health claims (Talati et al., 2017). Still, their effectiveness on actual healthy purchasing decisions is highly debated, and public health officials seem to have preferences and priorities that differ substantially from those in the food industry (Julia & Hercberg, 2018).

Using absence claims on products that have never contained fat or sugar may not make much sense to well-educated consumers, but it may be considered informative by consumers with limited knowledge on food, who try to avoid these nutrients in their diet. In addition, the labels may suggest that the company is aware of specific health concerns, which may enhance the impression that the product contributes to people's health. Consequently, consumers may think the product supports their health, even though there may be no convincing scientific evidence to support such a claim.

In other cases, the use of a nutritional claim may make more sense, for instance when a health effect is likely but hard to prove. In that case, consumers may derive healthiness value from the presence or absence of particular ingredients, which may be expected to have an effect on specific physiological parameters and, thereby, on their expected health. Hence, although a health claim cannot be made based on solid scientific evidence, the presence of an ingredient can signal to the consumer that a product may be healthy. For instance, the EFSA has rejected many potential health claims for antioxidants (de Boer et al., 2014), but the inclusion of the implicit health claim "rich in antioxidants" on the package is allowed when an already approved health claim can be used to support this (Regulation 1924/2006). An example of such an implicit claim is the front-of-pack statement that a smoothie containing vitamin C and E is "rich" or "high in antioxidants". This is then further explained on the back by stating the authorised health claim that these vitamins "contribute to the protection of cells from oxidative stress". Other nutritional claims such as "rich in vitamin C" do not need the support of an approved health claim but could still implicitly convey healthiness to consumers. Many of these labels contribute to building a product or brand image, while they are hardly supported by evidence.

For claims on packaging to be effective, it is important that consumers understand and trust the claim. They must have sufficient knowledge to understand what effect the product or component is likely to have on the body. In addition, they must be confident that the claim is based on solid scientific evidence and that there are procedures in place that assure that the acclaimed effect has been demonstrated. In a recent online survey of staff and students at a Portuguese university, many participants (66%) said they found the compulsory information on food labels useful, but many also experienced some difficulty understanding them (64%) or doubted whether the product was correctly described (60%) (Moreira, García-Díez, de Almeida, & Saraiva, 2021). Some studies suggest that only 30–40% of consumers possess sufficient knowledge to understand packaging information (Dutch Ministry of Health Welfare and Sport, 2005). Nevertheless, consumers themselves

rated the understandability (median 2.8–3.8 on a 5-point scale) and credibility (median 3.0–3.7) of officially approved health claims as satisfactory in a representative sample of European consumers (Hung & Verbeke, 2019).

Little is known about consumers' knowledge with respect to the legislation for food packaging information and the procedures that ensure the correctness of claims. The few studies on this topic indicate that consumers seem to be only partially aware of what information producers are obliged to provide on food packaging (Krnácová, 2016), they are unaware of the system that imposes strict requirements on manufacturers to obtain approval of a health claim, and they appear to be sceptical about many health benefit claims (Di Fonzo & Liberati, 2020). Regarding the trustworthiness of claims, Lockyer, Ryder, Jaworska, Benelam, and Jones (2020) found in a social media poll among 440 consumers that only a small percentage chose that they definitely believed that claims on food labels were based on solid scientific evidence (21%), while the others chose the option that it was pure marketing (79%). These observations suggest that consumers do not believe that authorised claims are well substantiated.

A systematic review of the literature on the perception of naturalness (Román, Sánchez-Siles, & Siegrist, 2017) shows that for the majority of consumers in different countries and measured over several years, naturalness is important when choosing products. Based on a content analysis of the items used to assess the importance of naturalness, these authors revealed the following three categories of aspects that contribute to the evaluation of naturalness: 1) the way the food has been grown (organic, local), 2) how the food has been produced and processed, i.e. what technology and ingredients have been used (e.g., free from artificial substances, minimal processing, traditional production), and 3) the properties of the final product (healthy, tasty, fresh, eco-friendly). The label "natural" is likely to evoke the association of "healthiness" among consumers, without the need to provide substantive scientific evidence to support any acclaimed health effect, like providing evidence that natural products are better for people's health than more processed products. The concept of naturalness is interesting, because it also implies taking care of the environment (Hoek, Pearson, James, Lawrence, & Friel, 2017b). Although consumers find it much more logical to link food to health than to environmental issues (Hoek et al., 2017b) and people's motives for buying organic food seem to be traditionally dominated by the search for health and food safety rather than environmental concerns (e.g., Schifferstein & OudeOphuis, 1998; Soroka & Wojciechowska-Solis, 2019), the concept of naturalness is directly relevant for both fields and allows producers to elicit positive associations for both domains, without being restricted by extensive regulations.

As concerns the term "organic", Sanders (2013) concluded that most consumers in the EU were familiar with the main issues of organic farming, such as growing without the use of synthetic chemicals and genetically modified seeds and the use of production methods that protect the environment. However, some consumers surveyed mistakenly believed that organic food was produced on small farms or was produced locally. Abrams, Meyers, and Irani (2010) found that participants mentioned that "organic" products are expensive and they "don't taste as good, but it's better for you". Participants also thought that the welfare of organic animals would be better compared to conventional animals. The regular buyers of organic food also mention wholesomeness, absence of chemicals, and environment-friendliness as main reasons to buy organic. In addition, regular buyers tend to find that organic foods have a better taste than conventional products (e.g., Schifferstein & OudeOphuis, 1998). Similar associations have been found for the "all natural" food label in the US (Dominick, Fullerton, Widmar, & Wang, 2018).

Whether adding a verbal label on a package will convince consumers about the characteristics of the product, is a matter of trust (Carol & Brian, 2019; Monier-Dilhan, 2018). According to a qualitative study by Lwin et al. (2015) consumers associate the term "natural" with the absence of any food additives, but they tend to be suspicious about whether this is correct, and with good reason: nearly two thirds of all food labels that used the term "fresh" and more than one half of those using the claim "natural" also displayed information related to additives. Similarly, in a study on organic pork products Abrams et al. (2010) found that the majority of participants felt that the term "all-natural" basically meant "no"—no preservatives, no additives, no antibiotics, no hormones, no extra liquids in the meats, no phosphates, and no chemicals, but most participants also expressed scepticism as to the validity of the manufacturers' claim in this respect. Instead of using the "natural" verbal label, it would also be possible to refer explicitly to the absence of artificial additives. One might label products as "100% pure", "no preservatives", and so on, but we did not find consumer studies evaluating such claims. Other associations of naturalness for pork products were that the meat was derived from a real animal, preferably raised on a small farm, or fed with natural and/or organic foods. Another interesting point in the discussion about health claims and perceived naturalness is whether health claims can also decrease the perceived naturalness of a product? Very specific claims such as "calcium contributes to normal neurotransmission" may evoke associations with medical science and technology. This is likely to contrast with the artisanal, small-scale and natural image that many consumer brands try to create.

The main motivations to buy organic food include its wholesomeness, improved product quality and concerns for the environment. Researchers have generally supported these three as the most valid ones (e.g., Hughner, McDonagh, Prothero, Shultz II, & Stanton, 2007; McEachern & McClean, 2002), but on the basis of a meta-analysis Rana and Paul (2020) conclude that health is the most important of these three motivations. Although one of the primary reasons for purchasing organic food is its perceived higher nutritional value, literature reviews suggest that organic and conventional foods do not differ substantially in the concentrations of the various nutrients (Bourn & Prescott, 2002). Nonetheless, there might be a slight trend towards higher ascorbic acid content in organically grown leafy vegetables and potatoes. Furthermore, there is a trend towards lower concentration but higher quality of protein in some organic vegetables and cereal crops (Magkos, Arvaniti, & Zampelas, 2003). As regards the levels of various contaminations, organic fruits and vegetables can be expected to contain fewer agrochemical residues than conventionally grown alternatives. However, the significance of this difference is questionable, because actual levels of contamination in both types of food are generally well below acceptable limits (Magkos, Arvaniti, & Zampelas, 2006). Also, some leafy, root, and tuber organic vegetables appear to have lower nitrate content (Bourn & Prescott, 2002), but whether dietary nitrate constitutes a threat to human health is still a matter of debate (Magkos et al., 2006). No differences could be identified for environmental contaminants, while for endogenous plant toxins, biological pesticides, pathogenic microorganisms and mycotoxins available evidence was extremely limited or inconclusive (Magkos et al., 2006). As regards the sensory quality of organic foods, some studies indicate that organic and conventional fruits and vegetables may differ on a variety of sensory qualities, but Bourn and Prescott (2002) conclude that responses to organic products are not consistently better than those for conventional products or vice versa.

Before the development of US federal organic standards, organic food was linked to small farms, animal welfare, community support and other factors that are no longer associated with most organic foods today. Demand for local food arose largely in response to corporate cooptation of the organic food market (Adams & Salois, 2010). Consumers' interest in local food has steadily increased since the year 2000. Unlike organic food, local foods are not necessarily perceived as expensive. Nevertheless, consumers are willing to pay a premium for local food (Feldmann & Hamm, 2015). In their literature review, Feldmann and Hamm (2015) found that the most important reasons for buying local food were related to the product's quality (i.e. freshness and taste; the expected effects on personal health) and greater trust as it might be safer

and easier to trace back to its local producer. Other motives included environmental friendliness of the production process and transportation, support of the local economy and community, better conditions for farm workers and concerns for animal welfare. People who choose to eat local products frequently value relationships with farmers and food producers based on reciprocity, trust and shared values (Hinrichs, 2000; Marsden, Banks, & Bristow, 2002). Some may also see eating locally as a means to reconnect with rural roots and traditions (Bingen, Sage, & Sirieix, 2011; Montanari, 1994). However, consumer expectations are not necessarily supported by empirical evidence (e.g., Edwards-Jones, 2010).

Another concept that may elicit health associations concerns "freshness" (Hoek et al., 2017b). An extensive consumer survey asking supermarket consumers to describe when they considered fruits or vegetables to be fresh (Peneau, Linke, Escher, & Nuessli, 2009) found that freshness described a level of closeness to the original product, in terms of distance, time and processing. Respondents mainly mentioned descriptors referring to aspects that could be perceived through the senses (appearance, texture, taste/smell) (N = 339). Other aspects referred to the production location (N = 81) or the time of production (N = 71). Only a small number of descriptors referred to treatments during production and handling (N = 20), storage (N = 14) or presentation and packaging (N = 11). The less direct contact respondents had with the place of production, the more often they mentioned sensory attributes. The relevant sensory terms that determine whether a product is fresh or not differ between products (Heenan, Hamid, Dufour, Harvey, & Delahunty, 2009). These findings suggest that information on processing treatments and storage conditions has only a limited effect on the consumer perception of freshness in urban supermarkets. It is more important that consumers can directly perceive the products through their senses. Hence, using protective atmosphere, transparent packaging or refrigeration do not seem to interfere with being perceived a fresh, whereas foods that have been frozen, canned, or dried and wrapped in closed packages are likely to be evaluated as less fresh.

Consumers who see a verbal claim on a product do not necessarily process this information in a logical, rational way. Instead, they may process such information more intuitively. For instance, the well-known "halo" effect implies that one positive product feature may induce favourable opinions on other - seemingly unrelated - characteristics (Thorndike, 1920). Hence, using positive labels on product packaging may evoke other positive associations that are not explicitly communicated, let alone substantiated. A related phenomenon is positivity bias, which occurs when consumers evaluate products more favourably as a result of the presence of on-pack nutrition information, compared to similar products that do not display this information. For instance, Talati et al. (2016) found that the use of front-of-pack logos resulted in more positive evaluations of unhealthy foods, such as pizza and cookies. In general, specific packaging features, such as images, the use of a colour scheme or typefaces, can support the claim further. If certain pairs of stimuli are more likely to occur together or seem to fit together well, presenting one stimulus of the pair may increase a consumer's expectation that the other stimulus should also be present (Garber, Hyatt, & Starr, 2001).

3.2. Images

Information can be provided in the form of text as well as images. The effects of packaging imagery on consumer perception and response have been recently reviewed by Gil-Pérez, Rebollar, and Lidón (2020) and we highlight some of their observations here. Images depicted on packaging can function as salient cues that easily attract consumer attention (Piqueras-Fiszman, Velasco, Salgado-Montejo, & Spence, 2013; Varela, Antúnez, Silva Cadena, Giménez, & Ares, 2014) and are used to infer product information (Benn, Webb, Chang, & Reidy, 2015; Schifferstein, Fenko, Desmet, Labbe, & Martin, 2013). In addition, images are more vivid and their processing requires less cognitive effort than text, so they may generate product expectations more easily than verbal information (Benn et al., 2015). However, an image by itself is also ambiguous and can evoke multiple interpretations. Consumers will interpret such an ambiguous image by relying on the context in which it is displayed, for instance its congruence with the attributes of any other items shown (Gil-Pérez, Rebollar, Lidón, Piqueras-Fiszman, & van Trijp, 2019).

That said, it should be noted that text can also be ambiguous, especially when it comes to higher level constructs, such as healthy or natural. Where words can convey such abstract constructs through text, images must become more concrete. Hence, packaging designers will wonder: what kind of healthiness or naturalness should we communicate? Does healthiness refer to low salt content, less calories, more vitamin C, or absence of pesticides? Does it contribute to people's physical fitness, weight loss, bone strength, the quality of digestive processes, or mental resilience? Does naturalness refer to clean water, air or soil? Or does it mean greater biodiversity? Designers will have to choose between images, colours and typefaces, and different answers to these questions will imply different choices. Therefore, in the discussion below we will sometimes make explicit how a particular construct is interpreted in a specific study.

Packaging images often show the product contained in the package and/or the ingredients or food products that give it its predominant flavour. Some image cues may infer specific product properties: implied movement may imply freshness (Gvili et al., 2015), using highlights may imply juiciness (Di Cicco, Zhao, Wijntjes, Pont, & Schifferstein, 2021), and so on. Portion sizes displayed suggest how much is normally consumed and, thereby, affect the amount eaten (Madzharov & Block, 2010; Tal, Niemann, & Wansink, 2017). Additional food products may be depicted as serving suggestion for the main product. Such images tend to elicit sensory associations related to texture, appearance, and taste (Rebollar et al., 2017; Rebollar, Lidón, Gil-Pérez, & Martín, 2019). Depicting healthy foods next to the product may increase its expected healthiness (Rebollar et al., 2016; Zhu, Chryssochoidis, & Zhou, 2019). In addition, depicting the food in its edible, unprocessed form may enhance the perception of healthfulness and naturalness (e.g., using a raw orange rather than a glass of orange juice, or depicting tomatoes growing on a plant) (Steenis, van Herpen, van der Lans, Ligthart, & van Trijp, 2017; Szocs & Lefebvre, 2016). However, food producers should be careful about depicting additional food items on the package, as this could suggest that they are ingredients and thereby deceive consumers, which is prohibited by European law (EU Regulation 1169/2011) (Burges Salmon, 2015; EU, 2011).

Non-food images idealizing the product origins or production processes (e.g., a landscape or a farm) help to convey concepts like authenticity or quality (Barnes, 2017; Tempesta et al., 2010), while people tasting and enjoying the product are likely to enhance desire for the food and increase consumption (Poor, Duhachek, & Krishnan, 2013). Non-food images with a symbolic meaning may be used to communicate more abstract benefits, such as people exercising to convey the perceived healthfulness of the product (Chrysochou & Grunert, 2014; Oliveira et al., 2016). In some cases, metaphoric images may be used to communicate sensory information, such as a lion to convey strength or a fire to convey hot spiciness (Gil-Pérez et al., 2019).

3.3. Other graphic design features

The style of an image, the characteristics of a typeface, or the shape of a decorative graphical element can communicate to consumers on a denoted or on a connotated level. The denoted level refers to the direct, literal meaning, while the connotated level refers to the implicit meaning which may include symbolic aspects that can be of a cultural, methodological or ideological nature (Moriarty, 2004). In the previous section, we mainly addressed the denoted level, whereas in the following section we focus more on the connotated level.

3.3.1. Visual design of an image

The elements depicted in the image affect consumers, as do the visual qualities used to display them. For example, it has been argued that illustrations are more effective in promoting organic food than real photographs (Septianto, Kemper, & Paramita, 2019). In addition, the design style may appeal to different audiences. For instance, cartoon characters may be helpful in increasing the intake of fruit and vegetables among children (Kraak & Story, 2015).

3.3.2. Colour

The main colour of the packaging may have an important effect on the success of the product and can even influence taste perception (Rebollar, Lidón, Serrano, Martín, & Fernández, 2012). On the supermarket shelf, the product should be noticed among many competitors. Products should grab the attention of potential buyers in an instant (Garber et al., 2008). New and unknown food products in particular need to be presented visually, so that consumers can get a visual impression of the product. Colour can attract attention in a very short time, convey product-specific messages and contribute to brand identity. Each colour is associated with a different emotion spectrum (e.g., Valdez & Mehrabian, 1994; Whitfield & Wiltshire, 1990) and can evoke different associations for different foods. Colours can indicate the flavour of the food (e.g., beige for white chocolate, blue for milk chocolate, red for dark chocolate), but can also indicate the quality (e.g., white for low-cost, bright colours for basic, black and gold for high-end or premium). The background colour of a package can also influence the expected sensory properties. For instance, Deliza, MacFie, and Hedderley (2003) found that with a white background an unfamiliar juice (passion fruit) would be expected to be fresher and purer, but less sweet than with an orange background.

The choice of colour is important in the context of the product and packaging, including consideration of how to display images as part of the packaging design. The associated meaning of a colour can vary depending on the physical and cultural context (Labrecque, Patrick, & Milne, 2013). Consumers are likely to associate specific colours with particular meanings, due to repeated exposure as well as their associated symbolic meanings (Schuldt, 2013; Vermeir & Roose, 2020). For example, the colour red is a highly symbolic colour that can indicate anger or a threat, but it is also the colour of ripe fruits (Elliot & Maier, 2014). The colour green is associated with nature and environmentally conscious consumption (Vermeir & Roose, 2020), which may have a health connotation for some product categories (Festila & Chrysochou, 2018; Schuldt, 2013). A prominent example of using the colour green to emphasize a company's environmental claim was made by McDonald's in 2009. The company's dominant red background was replaced by a green one in Germany in an attempt to reposition the company as environmentally friendly (Spiegel International, 2009).

In Europe, healthy product variants that contain less unwanted nutrients (salt, fat, sugar) are usually marketed with lighter, unsaturated colours (Festila & Chrysochou, 2018; Karnal, Machiels, Orth, & Mai, 2016; Tijssen, Zandstra, de Graaf, & Jager, 2017). Hence, the colour palette used for packaging design can also provide clues about the expected health implications of the product, even though such associations are not based on links to the content of images, but rather are due to conventions that have evolved over time. The choice of colour, therefore, requires a thorough investigation, in order to select the most suitable one (Mastropietro von Rautenkrantz, 2016).

3.3.3. Icons, symbols, and logos

Shapes can have a strong symbolic meaning, which could potentially emphasize food-related claims. For example, the use of a leaf silhouette as part of packaging design could signify "nature" and "sustainability". Such forms are also called pictorial representations. The field of semiotics differentiates between the different levels of abstraction that such pictorials can have, distinguishing whether they visually resemble the object referred to (icon) or whether their form is unrelated to the object it represents (symbol) (Abdullah & Hübner, 2005; Moriarty, 2004). Packaging designers commonly use established symbols and icons and may even develop new ones to emphasize the intended meaning of the packaging. Many icons, symbols and logos (which may consist of icons and / or symbols) are subject to strict legal, ethical and commercial guidelines that restrict their use (e.g., the Nutri-Score logo). However, consumers may interpret such shapes differently from the designers' intentions, and the introduction of new symbols can be challenging. For instance, Sanders (2013) concluded that most consumers in the EU understood the concept of organic farming, but did not recognise the EU organic logo introduced in 2010. About a quarter of all respondents had seen the EU organic logo before and only 13% considered the EU organic logo relevant to their purchasing decisions, even though the level of trust in the logo was relatively high.

3.3.4. Typeface

Written text conveys the literal meaning of words, but it also conveys implicit meaning through the typeface, as consumers can perceive symbolism through its visual features. Over time, artists and designers have developed different typefaces and ways to place them on a graphic surface. Such typefaces can thus be used to express a particular "Zeitgeist". For example, the "neo-retro" design style often employs typefaces reminiscent of the Victorian style to create the intended "vintage" look (Celhay, Magnier, & Schoormans, 2020). Celhay, Boysselle, and Cohen (2015) showed that a typeface can express different exotic origins of a product, depending on the specifications and details of the typeface. Velasco, Salgado-Montejo, Marmolejo-Ramos, and Spence (2014) indicate that typefaces can influence taste perception. Sweet tastes are better expressed with typefaces with rounded features, while sour tastes are better expressed with more angular typefaces (Velasco, Hyndman, & Spence, 2018). Schroll, Schnurr, and Grewal (2018) showed that handwritten typefaces can even create the perception of a human presence and foster an emotional attachment between the consumer and a product.

Despite the longstanding tradition of developing typefaces and refining typesetting and printing, there is little research into the effect of typeface on associations of health and naturalness. Nonetheless, Karnal et al. (2016) link health to the weight of a typeface, suggesting that a delicate typeface could symbolically convey the concept of light and thin, whereas a bold typeface could convey the opposite concept of heavy and fat. In their study, they found the expected effect of typeface only for consumers with a more pronounced focus on health promotion. Currently, there are no regulations concerning the typeface that can be used on packaging design, except for EU regulation 1169/2011, which requires a minimum x-height of 1.2 mm for information displayed on the packaging (e.g., ingredients list) to secure readability of the text (EU, 2011).

3.3.5. Composition and position

According to the embodied cognition framework, the representation of concepts is grounded in direct bodily experience within the physical world (Lakoff & Johnson, 1980). For example, the position of a spoon in a bowl on the right side may facilitate the act of consuming and thus invite physical interaction (Elder & Krishna, 2011). Placing an object higher on the vertical axis may suggest that it is lighter or of a higher quality (Machiels & Orth, 2017; van Rompay, Fransen, & Borgelink, 2014). Analogously, an image made with an upward camera angle reinforces the perception of luxury (van Rompay, de Vries, Bontekoe, & Tanja-Dijkstra, 2012). Alternatively, the horizontal axis of the packaging can suggest a timeline (Chae & Hoegg, 2013), whereas the composition and layout of the images may convey concepts like care and closeness (Te Vaarwerk, van Rompay, & Okken, 2015).

3.4. Packaging material

Another element that can influence perceived health and

sustainability is the materiality of the package and its content. Materiality in this context can include the sensory experiences of sight, touch and sound (Labbe, Pineau, & Martin, 2013; Schifferstein et al., 2013). Labbe et al. (2013) showed that the expected naturalness of food was related to the roughness and flexibility of the packaging material that only produced low sound intensities. Similarly, rich texture patterns can resemble the presence of vegetable fibres (Nikolaidou, 2011). These features can evoke associations with imperfection and connection to nature, while glossy, smooth and stiff materials appear more processed and artificial. Therefore, using plastic-based materials is unlikely to give packages a natural feel and image. Also note that the materials with natural associations may actually be more sustainable as they tend to be biodegradable. Analogous to naturalness associations, Fenko, Kroese, and Karreman (2017) showed that products wrapped in cardboard paper were judged to be healthier than products wrapped in plastic. Although glossy packaging materials may be associated with tastier foods, matte materials are generally associated with healthier items (Vermeir & Roose, 2020; Ye, Morrin, & Kampfer, 2020). Please note that when it comes to choosing packaging material for food items, the material also has to align with food safety standards, which are regulated by law (Marsh & Bugusu, 2007).

4. Ethical considerations

Food producers need to make choices regarding the way they present their products in the supermarket and the packages they develop. Companies may use different strategies, based on the goals they would like to achieve, which are connected to the values they endorse (Quigley & Watts, 2005). In the sections above, we have presented an overview of legal restrictions that governments have created and that limit companies' freedom, to protect consumers from misleading and false advertising of food products and their effects. Nonetheless, companies still have a lot of freedom, and their values will affect the extent to which they use this freedom to communicate to consumers. Historically, the food industry has favoured self-regulation, arguing that it allows for quicker, more creative, and more flexible responses to problematic marketing than government regulation (Majoras et al., 2006), but consumer advocates have argued that self-regulation does not bring enough improvement.

Barnhill and Civita (2020) describe several matters that hinder the development of good regulations and rules of conduct. First of all, it is difficult to determine which foods can be considered healthy and which are not. Although there seems to be sufficient consensus about the healthfulness of some dietary patterns (e.g., diets high in fruits and vegetables and low in added sugar are healthier than the reverse), there is less consensus on other matters (e.g., the health effects of saturated fat). But even if we can identify what a healthy dietary pattern may look like for an average person, this cannot be translated directly into evaluations of the relative healthfulness of individual foods (Jacobs & Tapsell, 2007). Furthermore, existing regulations do not necessarily reflect current and emerging scientific insights and may be outdated (de Boer, 2019). This raises questions about whether governments are obligated to regulate in ways that respond to the evolving scientific consensus. In addition, there may be tension between the healthfulness of products and sustainability aspects, such as their impact on the environment or farmers' working conditions (e.g., Schebesta & Candel, 2020). For example, Barnhill and Civita (2020) describe the case of almonds: Although eating almonds may be recommended by many nutritionists, their health benefits may come at the expense of those who live and work in the regions where almonds are produced. Most of the global almond production takes place in the San Joaquin Valley in California and consumes a lot of water, while this region has experienced severe drought conditions and depletion of the aquifer in recent years (Pierson, 2014).

These different issues indicate that in some cases it can be difficult to determine exactly what kind of company behaviour is problematic, because it may be unclear when a product is healthy or environment-friendly. The last example shows that tension can exist between different desirable product aspects, raising the question of how such products can be marketed in a way that is informative and not misleading, especially since positivity bias or halo effects may suggest that products have more beneficial effects than they do. And then there is another category of persuasive information that is strictly spoken incorrect, but which we might expect the public to be aware of. For instance, is it unethical to communicate that an industrial food product is natural and artisanal, even though it is processed in a large factory? To what extent should consumers be expected to seek information about food, dietary contributions, and the relative healthfulness of alternatives from sources other than the food industry, such as a dietitian, general practitioner or the national nutrition agency?

In order to operate in an ethical fashion, it seems plausible to demand from the food industry to market food in ways that are highly transparent and informative, and minimally misleading. However, providing accurate information may be challenging in practice, due to the high degree of complexity involved. For instance, Sandin (2017) suggested presenting an aggregate measure of a food item's naturalness through a graphical representation with several axes, because naturalness may vary on multiple dimensions. Unfortunately, such a representation can be too complex to be practical and still only cover some of a product's potential benefits. Nevertheless, companies that want to take their social responsibility could help develop communication approaches that encourage consumers to engage in healthy and environmentally friendly behaviours.

For the moment, consumers should probably not expect too much from companies' ethical behaviour. Bone and Corey (2000) found that ethically-interested consumers perceived a greater likelihood, severity, and concentration of possible negative consequences from questionable packaging practices than did brand managers and packaging professionals. Although the mean moral value scores were equivalent in the different groups, the business professionals indicated that a greater number of issues should be considered in order to be successful in business. Companies who undertake environmental improvements in their products may do so out of a desire to be more socially responsible or to meet the needs of socially responsible consumers (Polonsky, 1995). However, in their study on dishwashing liquid bottles Polonsky et al. (1998) concluded that a majority of the packaging information on environmental aspects was not accurate. The impact of such inaccurate information may be considerable, because it frustrates consumers' efforts to contribute to society, it does not provide an inspirational example to competitors, and it does not contribute adequately to the improvement of environmental health.

5. Practical implications

While the general rule is that packaging information should not be misleading, current laws and regulations only make this explicit in the area of health and nutrition claims, while it is largely lacking in many other areas. The rules and regulations of democratic countries typically reflect what governments consider important, partly based on debates in parliament and in the public domain. Therefore, they should ideally reflect the values and priorities in a society. However, the way rules and regulations are formulated also depends on what can be made explicit in written rules and on the ways in which these rules can be enforced. For example, legislators tend to use technical descriptions and require claims that are scientifically correct, but seem to be less concerned about how consumers interpret and use such information. While the claims may be technically and logically correct, the content does not necessarily reflect how consumers interpret them.

The strict regulations for health and nutrition claims pose a major dilemma for companies who would like to communicate the benefits of their products to potential consumers. Companies need to determine whether it is worthwhile to gather scientific evidence to substantiate a

health claim, as many proposed claims have been rejected during the application process. Given the fact that the approved claims tend to be long, not easily accessible, and not attractive to consumers (Lockyer et al., 2020), investing in a health claim may not be commercially worthwhile. In contrast, other positive product aspects may not require an official approval process and may have a greater positive effect on product attractiveness and purchasing intentions. Businesses are allowed to make claims in many areas (e.g., tasty, artisanal production, contributes to biodiversity, supports local communities) that do not require extensive evidence, although public attention in conventional or social media may question any unfounded claims. In some cases, complying with the requirements of a private organisation and obtaining their certificate can help to support such claims.

It is important to realise that many food products that are typically considered healthy, like fruits and vegetables, are sold fresh and are wrapped in little packaging material. The packaged products we considered in this paper have been processed and preserved and might be considered less healthy than the unprocessed foods without packaging. Many consumers seem to prefer fresh products, implying mainly that buyers can perceive the foods they buy directly through their senses (Peneau et al., 2009). Products that have been minimally processed to improve shelf-life and can still be inspected visually (e.g., using protective atmosphere and transparent packaging material) will be evaluated as fresh. In this case, the visual inspection of the product is more likely to convey healthiness than any claim, image or logo on the package. Food products packaged in opaque packaging can easily get rejected (Labrecque et al., 2013), which explains why transparent packaging has become increasingly popular over the years (Hisano, 2017), as showing the product itself may be the best type of advertisement.

In this paper we focused on the communication of health and environmental aspects of food products through packaging design. Both aspects are important in supporting a stable food supply and a healthy population, but both aims may be hard to achieve simultaneously in practice. Each of them individually refers to a complex set of considerations with multiple possible implications that may have conflicting effects. At the same time, many logos and claims related to environmental aspects of foods currently only deal with one aspect of sustainability, whereas consumers may associate sustainability also with social and animal welfare considerations next to environmental and health aspects (Brown, Harris, Potter, & Knai, 2020). This may increase the difficulty to develop transparent claims and logos and use these to clearly communicate the benefits the product offers. In addition, calculations comparing the amount of greenhouse gas emissions with adherence to dietary guidelines showed that improving diets on either health or environmental aspects typically does not lead to a substantial improvement on the other aspect (van de Kamp et al., 2018). How are people going to determine which products to support if they are unable to assess which ones obtain the requested effects?

Then we also have the question of how to optimise communication? Our literature review shows that products that communicate that they have health benefits are often evaluated as less attractive, which hampers their widescale acceptance. For instance, food products with light packaging colours are recognised as healthy, but are also evaluated as less tasty (Tijssen et al., 2017). Furthermore, food packages that display their health benefits by referring to scientific findings or a medical context by displaying representations of protective mechanisms, beneficial bacteria or respective body organs seem to lose their aesthetic appeal (Schifferstein, Lemke, & de Boer, submitted for publication). If communicating such positive effects has detrimental effects on product sales, this prompts the question whether producers should be honest about the beneficial effects of their products or can better remain silent about them? It has been suggested that we need a paradigm shift from "healthy food = requires compromise" to "healthy food = tasty" in order to increase consumer acceptance and support healthier food choices (Mai & Hoffmann, 2015). On the other hand, many food products claim they are healthy, even though they contain large amounts of unhealthy constituents. So apparently, there may be beneficial effects of claiming a product is healthy, and the challenge will be to figure out what claims have positive effects and what is the best way to communicate such information.

As described in this review, large amounts of information are conveyed to consumers through food labels, ranging from mandatory information about ingredients and allergens, to voluntary information provided about health effects or environmental friendliness. Whereas various aspects are regulated strictly, most voluntary information provided is – other than that it should not be misleading – not bound to any legal requirement. At the same time, designers of food labels need to make many decisions regarding how to convey this type of voluntary information. Even though ethical considerations from food producers and packaging designers could support the transparent use and application of claims and logos on foods, this review highlights the complex nature of the trade-offs needed to optimise such information and the effects it may have on consumers.

6. Ethics statement

The authors have complied with the ethical guidelines for journal publication.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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