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An exploratory study using graphic design to communicate consumer benefits on food packaging

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ABSTRACT

Commercial food packages may contain multiple messages. Packaging designers try to integrate all messages into a coherent design. Designers may use text, images or stylistic features, but these mediums may differ in their suitability to communicate specific product benefits. To evaluate the usefulness and effectiveness of these three mediums, we not only obtained consumer evaluations of packaging designs, but we also monitored the designer's experience during the design process.

For three products (orange juice, muesli bar, plain yogurt) we created three consistent packaging designs communicating a single benefit through all three mediums, which was either a [1] health, [2] environmental, or [3] production, sensory or social claim. Subsequently, we developed inconsistent packages communicating three different messages through the three mediums. In an online survey, each of the 18 package variants was evaluated by 59–92 participants.

Dummy regression analysis suggested that verbal claims had positive effects in communicating healthiness and environmental friendliness but elicited a negative tendency for sensory properties. The images we used indicated a positive effect for communicating worker conditions, but a negative effect for healthiness. Our stylistic elements suggested a positive effect for sensory appeal, but tended to have negative effects for environmental aspects. As regards designer dilemmas, we noticed that some images (e.g., in the medical domain) required specific graphic styles to make them acceptable for commercial use. Our findings suggest that consumers can handle multiple packaging messages, but finding an optimal configuration remains a design challenge.

1. Introduction

Food packaging not only functions as a container that keeps its content safe and fresh, but also provides a means to communicate the value of the contents and persuade potential consumers to purchase it. As a consequence, commercial packages may carry many different messages. But what is the best way to communicate a certain message? Besides using a text announcing a particular product benefit, graphic designers may convey a message through the images they use or the style of the packaging design. This offers a certain creative freedom, but also presents a dilemma because the various components must be clearly recognizable to the viewer and should also be integrated into a cohesive design. A designer must consider and balance the various elements while establishing a visual hierarchy that allows the viewer to quickly decipher the essential message of the design (e.g., what the packaging contains) (Lupton & Phillips, 2008). These design decisions are influenced by marketing considerations (e.g., which benefit should be noticed first). In addition, design principles affect how the different elements are perceived (Kimball, 2013), for example that objects that are close together or share similar attributes (color, shape) are often perceived as belonging to the same group (O'Connor, 2015). These design considerations and the underlying process can be quite complex when multiple elements need to be integrated and balanced. In this exploratory study, we are interested in the design process and the associated dilemmas. In addition, we want to investigate the effectiveness of different packaging elements in conveying specific product benefits. The research in this paper describes how a designer created multiple packaging variants for the same product, communicating different benefits in multiple ways, and it presents the results of an empirical study assessing how a sample of naïve respondents evaluated these packaging designs.

Because food packages are not developed by haphazardly combining

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design elements, we give a central role to the packaging designer in this study. Designers use a holistic approach in which they create coherent configurations of elements. Experimental studies that use a piecemeal approach with detailed manipulations or focus on communicating a single product benefit have only limited relevance to designers, as it leaves them with the difficult task of integrating the results of multiple studies in a single design and creating a coherent whole from a variety of elements. We think it is important that researchers who study packaging design become more aware that the mechanisms they reveal or the causalities they demonstrate may not be all that relevant for design practice. Hence, the development of other approaches to studying packaging designs are necessary from a pragmatic perspective, in order to be relevant to practical design questions.

Designers are trained to integrate elements into a coherent and appealing whole. Depending on the starting points of a design brief, they make specific choices for colors, fonts, shapes, configurations, and so on. They typically do not follow a set of formal rules but are guided by an intuitive process referred to as 'designerly ways of knowing' (Cross, 1982). Although their education teaches them how to make use of different types of tools and approaches to address often ill-defined problems within a given time constraint (Cross, 1982), each design process can be shaped individually (Dorst & Cross, 2001; Paton & Dorst, 2011). It consists of creative steps in which new options are created and decision steps in which choices are made between possible alternatives, but intuition, experience, values and norms, subjectivity and individual preferences play a large role in how ideas take shape, when decisions are made, and what their outcomes will be (Cramer-Petersen, Christensen, & Ahmed-Kristensen, 2019; Cross, 2004; Farrell & Hooker, 2014; Rittel, 1988).

Because we give our designer artistic freedom to create packages – just like a commercial client would when commissioning an assignment – our study differs substantially from most other studies that investigate the effects of design elements on the perception and evaluation of food packages. In our study, we include a variety of product benefits currently found on food products, including sensory claims, health claims, and claims from the sustainability spectrum (natural, animal-friendly, slave-free, artisanal). Because packaging designers and food marketeers are known to use multiple messages simultaneously in their marketing strategies, we ask our designer to create packages that display multiple aspects in concert (e.g., health, together with biodiversity and slave-free production). Rather than testing several packages that were developed by using factorial combinations of multiple specific packaging elements, we used a factorial design to develop instructions for a graphic designer and gave her the freedom to develop multiple packages.

This is the first study – to our knowledge – that explicitly considers the design process as an essential part of creating product packages. It seeks to study the creative process in a new and more ecologically valid way that is more comparable to how packages are developed in the food industry. We have developed a set-up for a quantitative study, in which we test how the creation of different design elements affects the perception of various consumer benefits. Because our manipulations involve instructing designers in different ways, packaging parameters will not be fully controlled in a physical sense. And because the packages we create are complex and vary in multiple respects, we also need questionnaires that allow participants to assess multiple packaging aspects simultaneously. As this is a first exploration, our study's set-up may not be perfect, but we hope that the outcomes will be interesting and inspiring for researchers and packaging designers alike. While the design elements are not strictly controlled, we are curious what effects will occur and we hope that our findings will spark ideas for interesting research hypotheses in future research, performed either in a realistic or more controlled setting. Overall, we hope that our study will lead to innovation in research approaches that have more practical relevance than the strictly controlled studies on fragmented elements of designs.

1.1. Products, benefits, and communication mediums

Consumer products typically appeal to their audience because they offer certain benefits that differ between the various offerings. In the food area, some of these aspects can be evaluated directly during consumption (e.g., tasty), while others will only influence the long-term (e.g., healthy), and some others cannot be verified at all and rely on the trust consumers have in the producer or retailer (e.g., produced in an animal-friendly way). In the present paper, we focus on how such benefits are communicated through packaging design and we include a wide variety of relevant domains in order to cover a variety of possible mechanisms. First, food consumption can impact human health and food packages tend to communicate information that is relevant to assessing whether a product is beneficial for health or not (nutrition, physical fitness). Second, the production and consumption of food can have an impact on the physical environment (biodiversity, use of scarce resources, pollution). Other product benefits include product quality (taste, shelf life), or the social and economic aspects of food production (working conditions, contribution to community, cultural heritage, small-scale production).

Packaging designers may convey product benefits through verbal messages, images, or stylistic features (choice of typeface, pictorial style, use of color and decorative elements), often following market trends or their gut feelings to address the client's design brief to develop suitable solutions. However, communication in the various domains may be tied to different rules and regulations. For instance, the domain of health and nutrition claims tends to be strictly regulated in many countries, considering not only texts that should or should not be used, but also the associated imagery (de Boer & Bast, 2015; Domínguez Díaz, Fernández-Ruiz, & Cámara, 2020). Environmental aspects are generally much less regulated, although the use of terms like organic and biological tends to be restricted. In contrast, the mentioning of many other aspects, such as sensory aspects, production characteristics and labor conditions are often not regulated by law, although they may be supported by public and private certification efforts (Schifferstein, de Boer, & Lemke, 2021).

The optimal communication strategy may differ between the various product benefits and although it is likely that commercial companies have studied these challenges extensively, there is only little research available on this topic in the public domain. Whereas the content of a text message is mainly informative, an appealing house style is more likely to address a consumer's intuitive feelings, while images are likely to evoke both. However, the exact wording of a text may also contain some more covert messages that can influence how a consumer feels, and stylistic elements may also contain clues that can activate cognitive associations (Celhay, Boysselle, & Cohen, 2015; Velasco, Hyndman, & Spence, 2018). The benefits we investigate differ on multiple dimensions (e.g., short versus long-term consequences; personal advantage versus other peoples' advantage or nature conservation), but at this point we have no predictions about how these dimensions might relate to the effectiveness of different communication strategies. Hence, it is part of our challenge to look for insights on how these different benefits can be communicated in an optimal fashion.

1.2. Text versus images versus style

Studies focusing on how people integrate information have compared presentations in text with those presenting information in an image (e.g., Vriens, Loosschilder, Rosbergen, & Wittink, 1998). In these studies, a text usually consisted of several items that were processed sequentially, whereas information in an image tended to be presented in a single overview and was processed more holistically (Paivio, 1971). However, this distinction seems less relevant for the current study because we intend to keep verbal claims short and we will use both text and images on each package. Therefore, we will focus here more on the unique properties of the different mediums in conveying specific messages.

Visual elements included on packaging designs can communicate to consumers on a denoted or connotated level (Barthes, 2007; Moriarty, 2004). The denoted level refers to the direct, literal meaning, while the connotated level refers to the more implicit meaning that can include symbolic aspects. In the case of text, the meaning of the words refers to the denoted level, whereas the shape and size of the letters may evoke associations that refer to the connotated level. For an image displayed, we might also make this distinction between the literal meaning of the scene displayed versus implicit associations. However, for an image these two meanings may be harder to disentangle, because the way in which an object or person is portrayed may also activate implicit meanings. Stylistic elements are likely to communicate mainly at a connotated level. Whether and how people will make use of specific information is dependent on the perceived relevance of the information, the accessibility of the information (Feldman & Lynch, 1988) and the trust in its source (Salaün & Flores, 2001).

An advantage of using images in a marketing context may be that images may capture buyers' attention better than texts. Presenting information in an image seems more engaging and vivid than presenting the same information through text (Underwood, Klein, & Burke, 2001). Processing visual cues seems to require unconscious and unintentional processing, while verbal cues require a higher level of cognitive effort (Underwood & Klein, 2002). This may be particularly important in current large-scale supermarkets, where shoppers need to find and select a product among many competitors. A virtual reality simulation showed that pictures on the package increased shoppers' attention to the brand, but this effect mainly occurred for low-familiarity, private-label brands (Underwood et al., 2001). However, García-Madariaga, Blasco López, Burgos, and Virto (2019) found that either images or short texts on packages both increased participants' level of attention.

In fact, textual information displayed on the packaging has an important effect on consumers' expectations of a product (e.g., Lähteenmäki et al., 2010; Liem, Toraman Aydin, & Zandstra, 2012; Sütterlin & Siegrist, 2015). Furthermore, the type of textual information seems to be important as well. A recent review suggests that interpretative food labels are perceived as more convincing than reductive ones (Hallez, Qutteina, Raedschelders, Boen, & Smits, 2020). Reductive labels provide information about key nutrition facts such as calories, fat, sugar and salt, whereas interpretative labels help consumers understand if the food content is good or bad by using specific scores or adding colors. These kinds of labels can be nutrition-specific or provide a summative average of the nutritional value (Ikonen, Sotgiu, Aydinli, & Verlegh, 2020). However, the review also indicated that consumers are more likely to be convinced by visual cues on the front of the pack than by text cues (Hallez et al., 2020).

An advantage of using text can be that its meaning appears clear and unequivocal. Nonetheless, the interpretation of text usually depends on the context in which it is presented. Therefore, a text can be ambiguous in itself, as its meaning can depend on the other words, images and objects with which it is encountered (Schifferstein, Smeets, & Hallensleben, 2011). The phrase 'a picture is worth a thousand words' already indicates that an image can be a more powerful medium to convey a message than text, because it tends to communicate multiple aspects and more details simultaneously. Still, the kind and amount of information in an image may vary, depending on the style of the image, ranging from pictorial (e.g., a photo) to nonpictorial (e.g., a symbol) (Samara, 2014). Fewer details can give more room to the observer's own interpretation. In addition, if the designer's intent is unclear, an observer may also be unsure of how to interpret a certain image. Hence, both text and images may involve ambiguous elements, whereas stylistic features are all connotative and thus even more open to multiple interpretations. In the case of ambiguity, past experiences, cultural traditions and design conventions may play a role in the interpretation of the various elements.

1.3. Design coherence

One of the advantages of involving designers in the creation of packages is that they assist in developing a design that integrates all demands and wishes (e.g., basic product information, usage instructions, brand information, and benefit communication) into a cohesive and aesthetically pleasing whole. Increasing the number of nonoverlapping concepts in a single presentation is likely to increase the challenge to come up with a coherent design and it will depend on the designers' skills to what extent they are able to integrate all concepts in the final design. If a designer is unable to create a coherent whole, the package design is likely to be perceived as confusing, less convincing or less attractive.

Although some principles have been described that explain why certain stimulus configurations are perceived as pleasant (e.g., Hekkert & Leder, 2008), the creation of such configurations is still the domain of creative professionals, such as artists, chefs, artisans and designers. In many domains, the study of which stimulus combinations are harmonious, balanced, or go together well have yielded only some guiding principles (e.g., Burchett, 1991; Locher, 1996; Lu, Kuang, Peng, & Li, 2015; Spence, 2020), but no strict sets of rules that can be followed and guarantee success. Therefore, we actively involved a designer in this study, and we regard her experiences during the creation of the different packaging designs as an integral part of our investigation.

1.4. Present study

In this paper we focus on the communication of benefits in different domains through food packaging design. These domains concern health, environment, sensory perception, social context and ways of producing. A single food product may offer interesting benefits in multiple domains, but its package offers only limited possibilities to convey these messages. On the one hand, every package is restricted in size and thus can contain only a limited amount of information. In addition, communicating multiple aspects may decrease the coherence of the product proposition, thus leading to inconsistent messages that may confuse rather than excite potential buyers. This creates a dilemma for packaging designers, because leaving out some of the information may result in a failure to attract potential buyers, whereas including too much information may result in an incoherent if not incomprehensible package design that buyers may dislike.

We investigate if and how designers can use different mediums (text, image, style) to communicate multiple product benefits through the packaging designs for three products. In particular, we would like to find clues as to whether some mediums are more suitable for conveying certain consumer information than others. Rather than using a strictly controlled experimental approach in which the combination of different design elements would follow a factorial arrangement (e.g., García-Madariaga et al., 2019; Rebollar et al., 2017), we provided a graphic designer with instructions for the design and allowed her the freedom to create coherent packages, following common rules of design practice. This approach resembles the way in which designers are briefed when they receive an assignment from a food company, thus contributing to the external validity of the study. Our investigation evaluates both the design process and the consumer perception of these packages.

First of all, we were interested in the dilemmas the designer would encounter when she separated the mediums for communicating different messages, but nonetheless tried to design a visually appealing and coherent package. Second, we tested how each of these packages were perceived by consumers in an online survey and we used dummy regression analysis to estimate the effects of our interventions on consumer perception. Third, we were interested in determining how these changes in the experimental set-up would affect the interpretation of the study outcomes and the potential value of its findings.

2. Method

2.1. Study design

We created packages for three different products: orange juice, a muesli bar, and plain yogurt. All these products were processed, packaged foods, yet they differed considerably in their ingredients, the way they were produced, and the types of consumer benefits they could provide. This allowed us to study a wide variety of benefit claims, as not every type of claim is relevant for every product. In addition, the commercial packages of these products often carry information that the food producer voluntarily provides, next to the mandatory nutritional and allergy information, which contributes to the ecological validity of our study.

The packages that we designed communicated information on three types of benefits: (a) health; (b) environment; and (c) other benefits, which either concerned sensory, social or production aspects. To communicate this information, we distinguished between three different mediums: (a) verbal, textual information; (b) images; and (c) stylistic elements. For each product, we developed three consistent packaging designs that communicated a single benefit through all three mediums. We also developed three mixed versions (inconsistent designs) that combined elements of three domains, following a 3×3 Latin square design. For example, by using a verbal health claim with an image showing an environmental topic in the style that emphasized the product's sensory quality, we mixed package elements from three domains in a single package. We tested the developed designs with an online survey. The study protocol was approved by the Human Research Ethics committee at Delft University of Technology.

2.2. Design of the food packages

A packaging design consists of two main elements: the overall shape of the packaging and the visual elements on the surface. Because we focused on the visual elements of the design using different graphic design elements, we chose to use a single packaging form for each product type as the basis for the different design variations and developed digital photo-realistic images of the different packaging designs. For orange juice we opted for a 1 L package, for the muesli bar a wrapper for a 40 g bar, and for yogurt a 500 ml beaker.

The graphic designer (M.L.) started by designing the three packages of each product that consistently conveyed a single message. Starting point for these designs was the claim that communicated a specific consumer benefit. Based on the verbal claim, we decided upon the content of the image that would communicate this benefit and defined specific style elements that had to be included. In design practice, such design requirements are communicated by the client (e.g., manufacturer) to the designer in the form of corporate or brand style guides that outline relevant design aspects such as color schemes, corporate typefaces, image styles or type of wording used in official communication. We based our definition of elements on an informal review of similar packaging designs available in the Netherlands.

The choices were summarized in Tables A.1–3 (see Supplemental Materials) and used as a basis to develop the different consistent designs. The motivation for these choices will be described in the following sections. Subsequently, the designer started looking for the best images and additional style elements that would convey the message. She chose a logo consisting of a brand name and icon, the color scheme and choice of typeface. The designer combined the visual elements digitally using Adobe Photoshop CC (2018) software to create a photo-realistic image of the packaging. Then the designs were presented to the co-authors and further adjustments and refinements were discussed. If an element proved to be difficult to access or to include in the overall design, alternatives were discussed and defined. For example, in the process we decided to use verbal claims with a similar length to secure the readability of the text. After developing several options, the designs were iteratively improved until the team of authors was satisfied with the proposals for the consistent packages.

Based on the choices made for the consistent packages, the specifications for the mixed packages were then created and the same procedure was used to develop three packages that integrated various elements of three different packages into one. The descriptions of the consistent packages (H for health, E for environment, and O for other) are listed in a single row in Tables A.1-3 in the Supplemental Materials. For the inconsistent packages, we picked information from 3 different rows according to a Latin square design. Mix1 combined the healthy text with the environmental image and the other style. Mix2 combined the environmental text with the other image and the healthy style. Mix3 combined the other text with the healthy image and the environmental style.

As an additional rule in the design process, the designer had to place the different design elements on a layout grid to achieve a consistent visual placement of the different elements. The designer developed the grid based on the reading direction from the top left corner to the bottom right corner based on Western writing style (see Fig. 1). For the muesli bar, we used two different layouts. The choice depended on the length of the verbal claim and the choice of the image, because the grid of Layout A caused readability issues when the image in the background was quite detailed. The resulting packaging designs can be found in Figs. 2–4.

2.2.1. Text

The text elements included a product name and a package size designation that were identical for each package variant, supplemented with a verbal claim and a fictitious product logo that differed between package variants.

2.2.1.1. Verbal claim. For each product we prepared three different types of claims:

- The health claims were derived from the constituents of the product. They referred to a nutritional claim (rich in vitamin C, rich in B vitamins) or referred to an ingredient of the product (contains live bacteria). The health claim was derived from an EU authorized claim for this ingredient (supports the immune system, activates your natural energy [in the body], improves lactose digestion [of the product in people who have difficulty digesting lactose]). Because some of these claims were longer than others, we shortened the longer ones by removing the text in brackets so that they were roughly the same size. These shortened claims were used to make the packages more comparable for the study and still reflected the language of the technically formulated authorized claims. Flexibility in wording is allowed by the EU, as long as the meaning of the claim does not change and provided that the full claim is stated at another location on the package, such as on the back or bottom of the package (de Boer, Urlings, Vos, & Bast, 2015).
- The environmental claims were organic, no use of pesticides (orange juice), contributes to an increase in biodiversity (muesli bar); and animal friendly (yogurt). These cover different aspects that are associated with the sustainable organic label.
- The other claims were refreshing (sensory claim, orange juice), slave-free chocolate (social claim, muesli bar); and artisanal production (production claim, yogurt).

2.2.1.2. Logo. Each package contained a logo consisting of a brand name and an icon. The brand names were chosen to reflect the verbal claims. The associated icons matched the brand names but were selected to be abstract and reduced in style, so that they could be used with multiple design styles. Although the icon is a pictorial (image) element, we included it among the text elements, to avoid inconsistencies between the brand name and its associated logo.

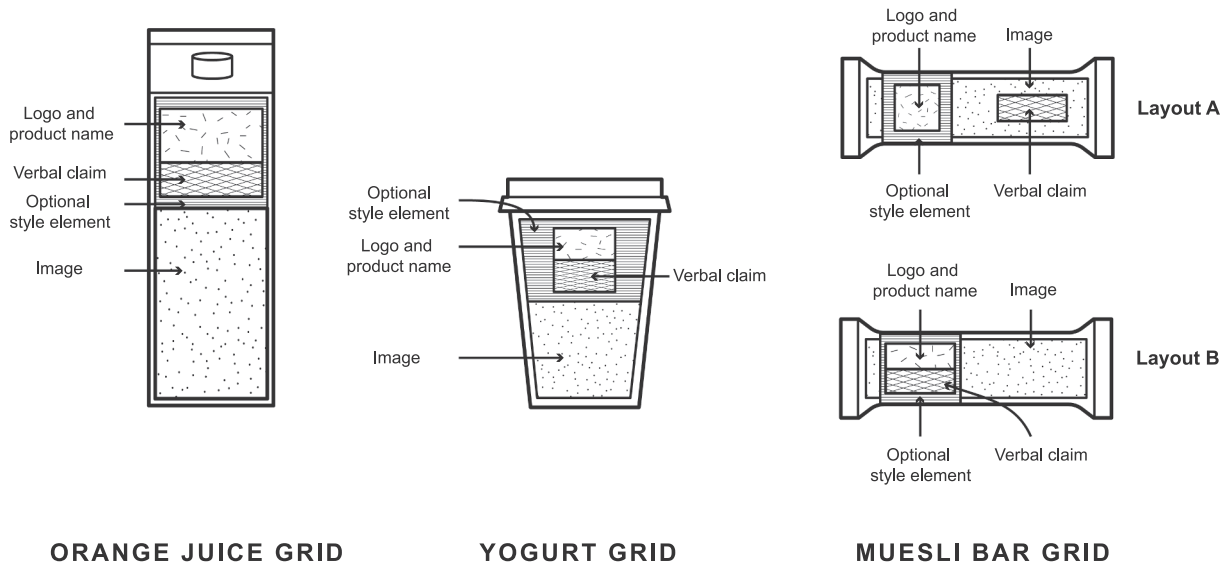

Fig. 1. Layout grids used as bases for the three product packages.

Fig. 2. Consistent and inconsistent designs for the orange juice. (For full color images, the reader is referred to the web version of this article.)

2.2.2. Image

In this study, when we talk about the image, we mainly refer to the content of the image that visualizes the benefits of the product. The images depicted food constituents (e.g., bacteria), the ingredients of the product (e.g., oranges, grain), the product being consumed (e.g., a person drinking juice), the way it was allegedly produced (e.g., a farm, cows in the meadow) or its associated benefits (e.g., people feeling fit, happy workers, a nature scene with several insects).

2.2.3. Stylistic elements

The style of the design included multiple graphic design elements: The choice of typeface and typeface pairings - when more than one

Fig. 3. Consistent and inconsistent designs for the muesli bar.

Fig. 4. Consistent and inconsistent designs for the yogurt.

typeface was used -, the pictorial style of the image (e.g., a drawing or a photo), the size and shape of decorative elements, and the choice of color. Each of these elements are discussed in more detail below. Often the choices of these stylistic elements were based on how certain elements were used in comparable product packages currently available in the market.

2.2.3.1. Typeface. We chose different typefaces to highlight the intended meaning of the packaging. For example, for the health packaging we used sans-serif and geometric typefaces to express a serious and fact-based brand. To highlight the environmental claim, we used a typeface with organic characteristics including serif and sans-serif variations, which had a hand-written appearance. This was done to convey the impression of a handmade product and small-scale production. For the other claims, we used variations of typefaces with strong visual features suitable for the different contexts. For example, we used a handmade typeface made from ice-cubes to emphasize the freshness of orange juice.

2.2.3.2. Pictorial style. For this study, we mainly used pictorial images, which show recognizable subjects such as people or objects, rather than nonpictorial images, which consist of abstract graphic shapes. We selected several pictorial styles for the packaging images, due to inconclusive results on the effect of pictorial style of images on consumer behavior (Gil-Pérez, Rebollar, & Lidón, 2020; Smith, Barratt, & Sørensen, 2015). The pictorial image styles exhibited different levels of abstraction from reality, spanning from literal to concrete (Samara, 2014). We call images literal if they capture reality in a clear and journalistic manner (e.g., a photograph). We speak of concrete images when elements have been noticeably edited or exaggerated by the designer, such as combining different photo elements into one photo-realistic image or imposing a specific visual language (e.g., making a pencil drawing). When we wanted to convey an impression of a depicted scene that corresponded to observable experiences, the designer used a

literal pictorial style in the form of photos, which are arguably the most empirical form of literal images (Samara, 2014). The designer looked for suitable photos by searching commonly used stock image databases. When she could not find a suitable photo or decided to use an abstracted visualization style, she used concrete pictorial images. Concrete pictorial images use a visual language that corresponds to some extent to a simplified, abstract reality and that allows for stylistic features. For example, in the O muesli bar package she used a gouache (watercolor) illustration of a woman carrying a few cacao pods to emphasize the brand's personal and local approach. For some packaging designs she created image collages by combining multiple visual elements into one composition. These were produced using Adobe Photoshop CC (2018), which allows designers to combine, adjust and resize various elements within the overall composition to emphasize the intended meaning. For example, for the E muesli bar she made an image that showed a meadow with butterflies and birds. The collage style made it possible to enlarge the butterflies and birds so that they were recognizable and not obscured by additional elements of the design.

2.2.3.3. Decorative elements. The designer used various decorative graphic elements to ensure the legibility of text components and to highlight the overall style of the packaging. For example, she added squares and circles to logos and text elements to increase the contrast between the text and the background. She also used graphic patterns associated with a specific cultural meaning. For example, the well-known Dutch 'Boerenbont' ornament consisting of a specific color scheme and floral pattern was used for the yogurt packaging to emphasize artisanal production. All decorative elements were chosen to emphasize the intended meanings and were carefully positioned to avoid competition with the included image.

2.2.3.4. Color. As part of the design process, we thought about how and what kind of colors should appear on the packaging, taking into account the perceptual dimensions of color hue, saturation, and brightness, as well as associated symbolic and cultural meanings (Heller, 2018). These design decisions were influenced by reviewing design precedents and studies investigating color in food packaging in particular (Ares et al., 2011; Festila & Chrysochou, 2018; Schuldt, 2013). The choice of the main color and color combinations influenced the way images were displayed (e.g., full-color range photos), as well as the color used for the typeface and decorative elements.

For the health-related packaging designs, we focused on full color range photos (orange juice and muesli bar) as well as images with a reduced color scheme (yogurt). For the decorative elements and typeface, we chose colors that are currently used as part of products that convey healthfulness. For example, we used red as a dominant color for the decorative elements for the orange juice, based on a content analysis of packaging designs in the US and in Denmark (Festila & Chrysochou, 2018). We used blue and white for the yogurt packaging design, based on the same study, which suggests that those two colors are most frequently used for yogurts with a health claim (Festila & Chrysochou, 2018). For the environmental claims, we used full color range photos and we put the color green in the foreground. For claims focusing on social and economic values, we based the colors on stereotypical color combinations such as blue, red and green associated with the Boerenbont pattern and the color brown with highly saturated and bright additional colors for the African-inspired packaging design. For the claim focusing on the sensory qualities of orange juice, we opted for a color combination of blue, white and orange to highlight the freshness of the product.

2.3. Participants

The questionnaire was developed with Qualtrics and distributed among participants living in the USA using Amazon MTurk. For each product 500 participants were recruited, and the allocation of product variants was determined by chance. Each participant rated only one of the six variants for a single product. We deleted responses that were suspected to be unreliable, because they were given very fast ($\leq$60 s) or were potentially generated by bots (reCAPTCHA score $\leq$ 0.50). Each variant was rated by 59–92 participants. The samples are described in more detail in the Supplemental Materials in Table B.

2.4. Questionnaire

After reading instructions, providing informed consent and completing a reCAPTCHA test, the participants rated the extent to which they agreed or disagreed with a number of statements on a 7-point scale. These items were generated to reflect the target consumer benefits to be communicated (healthiness, environmental friendliness, sensory appreciation, working conditions, and small-scale production) and some general packaging characteristics (attractiveness, convincingness, confusion). The items were: I think this product is … (healthy/nutritious/natural/fresh/tasty); I think this product … (is contaminated with pesticides/contains artificial additives/helps to stay fit/supports the human body/contributes to a balanced life); I think producing this product … (harms the environment/contributes to nature/supports the development of plants and animals/is done in a sustainable way/takes animal welfare into account/contributes to the welfare of farm workers/contributes to local communities/damages farm life/makes use of ingredients produced on small farms/makes use of traditional craftsmanship / takes place in large factories); I think this package is … (beautiful / enjoyable/sophisticated/tasteful); I find the information on this package … (consistent/confusing/believable/trustworthy). The 7-point scale contained verbal anchors for the 7 categories: strongly disagree – disagree – somewhat disagree – neither agree nor disagree – somewhat agree – agree – strongly agree. The items belonging to a single question were presented in random order that differed between participants. Images of the product packages were shown 5 times, interspersed between questions, to remind participants of the characteristics of the package design. Finally, the participants reported gender, age, and the countries where they were born and currently lived.

2.5. Data analysis

To determine whether some questionnaire items could be combined into a single construct or should be excluded from the composite measure, we combined the data for all three products in a single dataset. This aggregate dataset was used for Principal Components Analysis, the outcomes of which were used to create sum variables. These variables were used in all subsequent analyses.

Because the inputs for the package designs differed substantially for the three products, we performed additional analyses for each product separately. We started out with a manipulation check using ANOVAs to investigate the differences between the three consistent designs per product for the respective variables of interest.

To separate the effects of the three communication mediums (text, image, style), we used dummy regression analyses by creating a dummy for each medium. For each of these analyses, a target variable (e.g., healthiness evaluation) was used as dependent variable and the corresponding three dummies as independent variables. When investigating a particular domain (e.g., health), the corresponding consistent design was coded 1 on all three dummies, the other two consistent designs were coded 0 on all dummies, and the three inconsistent designs were coded 1 on one dummy and 0 on the two other dummies. A description of the datafile used for the dummy regression analyses can be found in the Supplemental Materials in Table C.

3. Results

3.1. Data reduction

Principal Components Analysis with Varimax rotation performed on the aggregate dataset yielded 4 factors with Eigenvalues larger than 1 and 64.4% variance explained (Table 1). The first factor (18.4%) was a Sustainability factor, containing items referring to caring for nature, plants and animals, but also to craftmanship and local communities. The second factor (17.7%) was a Wholesomeness factor with items referring to nutrition, healthiness and body fitness. The third factor (15.2%) was an Aesthetic factor referring to enjoyment and beauty, whereas the fourth factor (13.1%) contained all Negative items addressing potential damage to health and farm life, but also the potentially confusing nature of the packaging design. Items that addressed sensory pleasure of the food and reliability of the package information produced sizeable factor loadings on both the second and the third factor.

We mainly used this analysis to obtain homogeneous measures of our constructs of interest and remove items that did not fit within the sum variable. We created enough sum variables to represent all constructs of interest with a minimum number of variables. We grouped the items according to the object they addressed: either the food product, the way it was produced, or the packaging. Subsequently, we divided the items according to the factor loadings and the type of construct to assess. In some cases, we created multiple sum variables that loaded on a single factor. For instance, the items of the Social and the Environment variables both loaded highly only on the Sustainability factor, but we nevertheless regard them as separate variables, because they refer to theoretically different aspects that we manipulated independently when we created the packages. We then calculated Cronbach's alpha to evaluate whether the sum scales were homogeneous and the items measured the same construct (Table 1).

For the items referring to the product, we created a Healthiness, Sensory, and Contamination variable. For the production items, we distinguished a Social and an Environment factor. The three negative production items all loaded high on the Negative factor, but Cronbach's alpha increased from 0.796 to 0.864 when the item addressing large-scale production was separated from the other two. Therefore, this item was analyzed separately as Production and the other two items were combined in a Damage variable. The packaging items were divided

Table 1
Sum variables with loadings [>0.30] of the individual items on the 4 factors from the PCA and their alpha values.

	Factor 1 Sustainability	Factor 2 Wholesomeness	Factor 3 Aesthetics	Factor 4 Negative	Cronbach's alpha
Product					
Healthiness					0.903
healthy		0.811			
nutritious		0.786			
natural		0.663			
supports the human body		0.740			
helps to stay fit	0.368	0.682			
contributes to a balanced life	0.315	0.694			
Sensory					0.711
fresh		0.588	0.373		
tasty		0.474	0.518		
Contamination					0.790
is contaminated with pesticides				0.824	
contains artificial additives				0.788	
Food Production					
Social					0.836
makes use of traditional craftsmanship	0.676				
makes use of ingredients produced on small farms	0.720				
contributes to local communities	0.706				
contributes to the welfare of farm workers	0.702				
Environment					0.860
takes animal welfare into account	0.722				
is done in a sustainable way	0.694				
supports the development of plants and animals	0.761				
contributes to nature	0.704				
Damage					0.864
damages farm life				0.854	
harms the environment				0.854	
Production					
takes place in large factories				0.650	–
Packaging					
Aesthetics					0.900
beautiful			0.768		
enjoyable			0.799		
sophisticated			0.741		
tasteful		0.310	0.768		
Convincing					0.845
consistent		0.414	0.532		
believable	0.308	0.461	0.545		
trustworthy	0.383	0.434	0.545		
Confusion					
confusing				0.700	–

in variables addressing Aesthetics, Convincing information and a separate item measuring Confusion. All Alpha values of the resulting sum scales are acceptable. For scores on the sum scales, we calculated the means of the underlying items.

3.2. Manipulation check

We expected the H package variants to rate highest on the Healthiness variable, the E package variants to rate highest on the Environment variable and the O package variant to rate highest on the Sensory (orange juice) or the Social (muesli bar) variable, and lowest on the Production (yogurt) variable, respectively. These effects were tested by comparing the mean ratings for the three consistent packages using an F-test, followed by paired comparisons using t-tests.

These analyses showed that not all manipulations were entirely successful (Table 2). In fact, the Healthiness evaluations were only higher for H packages for the muesli bars, where images of athletes were used [$p < 0.01$]. The environment manipulations were more successful, obtaining the highest mean Environment ratings for all E packages, although the F-test only reached conventional significance levels for yogurt [$p < 0.01$], with marginally significant effects for orange juice and muesli bars [$p < 0.10$]. The refreshing O package for orange juice obtained the highest Sensory mean, but this was not significantly higher than for the other two packages. The slave-free O package for the muesli bar, however, obtained higher ratings on the Social variable than its competitors [$p < 0.05$]. In addition, the artisanal O yogurt package obtained the lowest ratings on the item addressing Production in large factories [$p < 0.01$], although in this case the difference with the animal-friendly E package was very small.

We also asked participants to rate the overall quality of the packaging designs, in particular the beauty of the design, the convincingness of the information and the degree of coherence between the different design elements, and the extent to which the participants found the package confusing. The ratings for the latter aspect might be higher for the three Mix designs, as they communicate multiple messages through the different mediums.

Table 3 shows that there are some differences for the Aesthetic appreciation of the packages. Participants rated the healthy orange juice and the healthy yogurt packages as relatively unattractive. The Mix3 packages that used similar images were also rated low for Aesthetic appeal. Interestingly, these Mix3 packages both also obtained relatively low Convincing scores. In fact, for yogurt the Convincing ratings of Mix3 were significantly lower than those of the H package. The data did not show any indications that Mix packages generated more Confusion than the consistent packages.

3.3. Separating the three communication mediums

To determine the contributions of the three separate mediums to the messages the participants perceived, we performed dummy regression analyses on the responses for the six packages, where each dummy coded for the presence of one of the mediums (text, image, style) in the target domain. A detailed description of the datafile used for the dummy regression analyses can be found in the Supplemental Materials in Table C. Although not all manipulations in the three congruent packages resulted in the anticipated effects, the F-tests comparing all six packages were generally significant (Table 2), showing that the six packages together showed variation on the corresponding dependent variables. As the coding of the dummy variables makes use of the way in which instructions informed the creation of the packages, the regression analyses are likely to be more sensitive in unravelling the effects of the manipulations on the target dimensions and are likely to reveal additional effects. We performed these regression analyses for the different target domains for each product separately. For the Healthiness and Environment scores, we also performed aggregate analyses combining the data from the three products.

Table 4 shows that we mostly found significant positive coefficients for the Text medium, suggesting that a verbal claim generally had a positive effect on the perception of the target dimension. We see this effect for Health, Environment, and Production. For the Sensory dimension, however, there tends to be an opposite effect: Saying that the product is refreshing seems to have a negative effect on the perception of freshness.

For the Image medium, the findings are mixed. The health images seem to lower the perception of Healthiness, especially for the orange juice packages. For the other dimensions the results generally point in a positive direction, with a significant effect enhancing the Social dimension in the muesli bars, and a marginally significant effect for enhancing the Environment scores for the orange juice packages.

The Stylistic medium also suggests both positive and negative effects. The stylistic health elements tend to contribute to the Healthiness perception of the muesli bars, but the environment-friendly style elements tend to have a negative effect on the Environment scores, especially for the orange juice. The most convincing positive style effect is found for the impression of freshness as reflected by the Sensory scores for the orange juice packages.

4. Discussion

For our study, we used three products for which we developed packaging signaling a message related to health, environment, sensory, social, and production, or a combination thereof. These products

Table 2
Mean ratings for the 6 packages on the target dimensions, with F-values comparing the 3 consistent designs or all 6 designs.

	H	E	O	Mix1	Mix2	Mix3	F (3P)	F (6P)
Healthiness								
Orange juice	5.46	5.67	5.48	5.70	5.57	5.27	1.41	2.17^{O}
Muesli bar	5.60^{a}	5.34^{ab}	4.98^{b}	5.54	5.46	5.11	5.69**	3.75**
Yogurt	5.61	5.60	5.48	5.55	5.33	5.24	0.55	1.97^{O}
Environment								
Orange juice	4.67^{a}	5.10^{b}	4.87^{ab}	4.96	5.06	4.55	2.88^{O}	2.77*
Muesli bar	4.81^{a}	5.26^{b}	4.94^{ab}	4.90	5.31	4.65	2.51^{O}	3.49**
Yogurt	4.57^{a}	5.26^{b}	4.75^{a}	4.69	5.11	4.57	6.63**	4.27**
Sensory								
Orange juice	5.53	5.68	5.78	5.76	5.67	5.33	1.37	2.24*
Social								
Muesli bar	4.73^{a}	4.81^{a}	5.22^{b}	4.87	5.32	4.92	4.01*	3.16**
Production								
Yogurt	5.00^{a}	4.44^{b}	4.20^{b}	4.67	4.33	4.31	5.08**	2.49*

($^{0}p < 0.10$, $*p < 0.05$, $**p < 0.01$; means with identical letters did not differ significantly in a *t*-test comparing the three consistent packages at $p < 0.05$).

Table 3
Mean ratings for the overall quality of the 6 packaging designs, with F-values comparing the 3 consistent designs or all 6 designs.

	H	E	O	Mix1	Mix2	Mix3	F (3P)	F (6P)
Aesthetics								
Orange juice	4.85[a]	5.29[b]	5.26[b]	5.29	5.17	4.57	3.14*	4.45**
Muesli bar	5.49	5.50	5.23	5.41	5.44	5.08	1.21	1.43
Yogurt	5.06[a]	5.26[ab]	5.63[b]	5.51	5.15	4.07[$]	4.30**	13.72**
Convincing								
Orange juice	5.33	5.59	5.31	5.50	5.64	5.12	2.05	2.77*
Muesli bar	5.42	5.30	5.33	5.50	5.54	5.10	0.20	1.35
Yogurt	5.38	5.37	5.52	5.43	5.34	4.82[$]	0.47	4.07**
Confusion								
Orange juice	3.25	3.49	3.30	3.45	3.07	2.97	0.34	0.92
Muesli bar	3.86	3.68	4.31	3.67	4.16	4.16	1.95	1.36
Yogurt	3.05	3.21	2.98	3.16	3.42	3.67	0.29	1.33

(*$p < 0.05$, **$p < 0.01$; means with identical letters did not differ significantly in a *t*-test comparing the three consistent packages at $p < 0.05$; [$] indicates a significant difference between H and Mix3 at $p < 0.05$).

Table 4
Standardized regression coefficients for the dummy variables representing the three communication mediums text, image, and style with F-values for the regression equation. More details can be found in the Supplemental Materials in Table D.

	Text	Image	Style	F-value
Health				
Orange juice	0.068	−0.133**	0.008	3.02*
Muesli bar	0.126**	−0.043	0.094[O]	4.77**
Yogurt	0.097*	−0.057	−0.001	1.54
Aggregate analysis	0.100**	−0.078**	0.034	6.84**
Environment				
Orange juice	0.121*	0.084[O]	−0.081[O]	4.20**
Muesli bar	0.180**	0.027	−0.067	5.63**
Yogurt	0.195**	0.035	−0.008	6.70**
Aggregate analysis	0.167**	0.046[O]	−0.054[O]	15.39**
Sensory				
Orange juice	−0.094[O]	0.066	0.101*	3.17*
Social				
Muesli bar	0.014	0.169**	−0.007	4.81**
Production[#]				
Yogurt	0.086[O]	0.076	−0.016	2.50[O]

([0]$p < 0.10$, *$p < 0.05$, **$p < 0.01$; [#] the signs of the coefficients for Production were reversed, to bring them in line with the other analyses).

(orange juice, a muesli bar and plain yogurt) were selected to exemplify a broad range of prepacked products that often carry information that food companies provide voluntarily. Selecting a diversity of products enabled us to evaluate product claims representing a variety of benefits. Our exploratory analysis suggests that a limited number of graphic cues may influence consumer perception of products and it shows the need to gain more insights into the complexity of food packaging design and the cues that influence consumer purchase decisions. Our designer developed ways to communicate these benefits through different mediums and our results suggest that not all these communication strategies are equally effective. This implies that different product benefits might require different mediums to optimize their impact.

4.1. Communication of target benefits

The three consistent packages did not always produce the highest scores for the target dimension. For the H packages only the muesli bar package was perceived as healthier than its competitors, possibly because it contained images of fit people (athletes), whereas the other H packages contained an abstract representation of an immunity barrier (orange juice) or the bacteria that promoted healthy intestines (yogurt). The E packages, however, were all perceived as significantly more nature-friendly than their competitors. In their study on perceptions of healthy and environmentally friendly food, Hoek, Pearson, James, Lawrence, and Friel (2017) concluded that the concept of product naturalness was related both to caring for the environment and to healthiness. In the latter case, because it was associated with using fewer chemicals and preservatives. Indeed, the current study suggested that E packages displaying animals in outdoor natural settings also promoted associations of healthiness, whereas the H packages did not increase nature-friendly ratings. Even joggers who run outdoors in a park (muesli bar Mix3) did not evoke associations of nature-friendliness.

As regards the O packages, the refreshing orange juice package did not obtain higher ratings on the sensory dimension. In this case, all three consistent orange juice packages apparently looked equally refreshing. The manipulation of the social dimension, however, was successful: Showing happy workers with ethnic patterns for the slave-free muesli bars yielded higher ratings than the packages showing athletes or insects in a meadow. The variation in production methods on the yogurt packaging showed that our artisanal packaging produced similar ratings for ‘takes place in large factories’ as the animal-friendly packaging showing cows on a pasture. This suggests that consumers think that animal-friendly practices and artisanal production both are hallmarks of smaller farms. This is in line with previous reports that consumers intuitively associate concepts like organic, no use of pesticides, and animal-friendly with small-scale production (e.g., Sanders, 2013).

Overall, these outcomes suggest that designing packages that communicate clearly distinct messages may be quite challenging, even for constructs that can be clearly separated cognitively: Although the evaluations of sustainability aspects were clearly distinguished from wholesomeness aspects in our PCA (Table 1), instructing our designer to make an environment-friendly package also evoked healthiness associations in all cases (Table 2). Given that an image is typically complex and may contain many details, it may be hard to find images that communicate one specific meaning without also activating other ones.

4.2. Overall quality of the designs

In terms of aesthetic appreciation, we found that participants rated the H orange juice and the H yogurt packages relatively low. The Mix3 packages that used similar images were also rated low for aesthetic appeal. In the H orange juice package, we tried to convey healthiness through a concrete pictorial style by combining an illustration of an immune barrier with a real photo of someone drinking juice. We used the colors orange and yellow to connect to oranges and sunrays. In the Mix3 variant we used the same illustration, but we recreated the image in a concrete pictorial style as a gouache illustration and we added lines to allow a clear distinction of the different elements. In this variant, green was the main background color to communicate environment-friendliness. In the H yogurt package, we showed a concrete pictorial

image showing bacteria. We used a white-blue color scheme to emphasize the health benefits of the product. In the Mix3 yogurt package, we searched for electron microscopy images of bacteria, because we wanted to stick to the visual style used in the E package. As these images are always produced in black and white, we tinted the image in green to align it with the rest of the package.

Even though we used color schemes that are typically used to communicate healthiness for orange juice and plain yogurt (Festila & Chrysochou, 2018), communicating healthiness benefits in the H packages proved difficult. For the orange juice packages the image of the immune barrier may have been too abstract and the participants may not have interpreted it correctly. Possibly, they may have associated it with high-tech medicine or beauty products, which commonly use such visual elements, rather than the natural support of the body's immune function. This could explain why ratings on environment-friendliness are also low. Similarly, the images of live bacteria on the H and Mix3 yogurt packages may have scared off potential consumers. Although we searched for electron microscopic images with aesthetic appeal and we abstracted the image on the H package to some extent, the view of these unknown creatures that ferment many of our food products and inhabit our intestines may have evoked associations of disgust. Possibly the elicitation of negative emotions, such as fear or disgust, might explain why the Mix3 packages that obtained low ratings on aesthetic appreciation also obtained relatively low convincingness scores.

Overall, the use of images presented challenges for the aesthetic qualities of the final package. Again, our discussion highlights that the experiential richness of images may lead to the activation of additional, unintended meanings that, in this case, had a negative impact on the overall evaluation of the package. Moreover, combining these images with unusual colors may have further enhanced such effects. Therefore, the designer's qualities in finding the right images and picking appropriate colors are probably essential in creating packaging that is attractive and also communicates the target benefits.

4.3. Design process

These findings relate to some of the observations we did during the design process of these packages. We noticed in the process that some of our initial images needed to show a certain level of abstraction to convey the intended meaning and to avoid a potential emotion of disgust. For example, we had initially planned to include a cartoon-like image (concrete image style) of intestines as part of the muesli bar design to indicate that the fiber content could facilitate the digestive process. However, during the creation of the Mix packages, it turned out that the literal style (real photo) of human intestines was rather confusing and did not convey the intended meaning. This made us aware that the depiction of internal organs in a realistic way is a common technique to evoke disgust in the context of health promotion campaigns (de Boer & Lemke, 2021) while health claims on food products show internal organs often in a more abstract, cartoonist way that might help avoid feelings of aversion and disgust (Lemke, Boon, & Schifferstein, 2021).

For example, products supporting digestive wellness like 'HI! Healthy inside' (Kellogg Company, 2018) use cartoon drawings and transparent sections as part of the packaging to illustrate the gut health aspect of the product line. In a promotional campaign for 'Danone Activia', the singer Shakira was shown with the image of a smiling mouth on her belly, instead of visualizing the improved intestinal passage the product claims to provide (Castañ, 2015). Others have used balloons representing intestines as part of promotional videos (The Gut Stuff, 2020). This use of a more abstract visual style might be able to provide a protective frame that makes the image acceptable by making the connection with body parts more abstract and, thereby, less confronting (see Fokkinga & Desmet, 2013). Consequently, we avoided using pictures of internal organs in our designs. This also explains why deterrent pictures used on cigarette packages to discourage people from smoking typically consist of realistic pictures of diseased organs. The outcomes of our study show that comparable principles can also apply to the use of images of bacteria.

In the design process, we also noticed challenges to define and use the style element as a separate entity in the study design. The style of an image, the characteristics of a typeface, or the shape of a decorative graphical element typically communicate at the connotated level (Moriarty, 2004), which refers to the more implicit meaning that can include symbolic aspects. In the overview of our instructions (see Supplemental Materials – Tables A.1-3), we tried to limit the description of the image to the more concrete, denoted meaning and we used the style details to define the intended connotated meaning of the image. For example, we used a watercolor illustration for the O muesli bar to evoke the impression of a contented farm worker in line with the 'slave-free' verbal claim. Separating elements in such a way might seem straightforward in theory, but these two elements are difficult to separate in design practice, since decisions often depend on the availability of specific images or the financial resources to purchase or develop the required images, illustrations and typefaces.

In the current study, we chose to provide specific instructions to a trained graphic designer and allow her to create realistic packaging designs, instead of artificially creating stimuli following strictly factorial combinations of design elements. This yielded a less controlled, but also a more ecologically relevant study. In addition, the insights the designer obtained during the design process add to our body of knowledge of the considerations that designers tend to follow. Up to now, experimental studies on packaging designs have mostly regarded images, text, and other elements as more or less separate entities that can be manipulated independently. In the current study, we made use of a designer's competences to integrate these elements into a consistent package. By giving the designer the freedom to create realistic, integrated package designs, we gave up complete experimental control. We handed the designer the instructions for making the designs, but we did not control the subsequent iterative steps that resulted in the final packages. Although we discussed the design proposals and made suggestions for amendments if needed, we did not control all the different steps and only approved the final designs. As a consequence, the sets of designs differ in the extent to which the same design elements have been used in the consistent versus the inconsistent packages for the three products.

In the case of texts, we made sure that they could be used for all packages without modification by keeping the quotes short. However, the designer used different images, colors and decorative elements in some cases. For the orange juice packages, the designer remained close to the original elements when designing the three Mix packages. For instance, in the Mix 1 package the image with the oranges and the leaves is very similar to the one used for the E package, although its concrete pictorial style was changed from an illustration to a photo collage. The style of the typeface mimics the character of the refreshing letters and copies the blue background color of the O package. For the muesli bar wrappers, however, the designer took more freedom. For instance, for the Mix3 design she used pictures of different athletes than for the H package. In this case, the association with the green meadow, being outside in nature, and the suggestion to use an image collage, which are all part of the E package style, prompted the designer to create a park with joggers and a yoga devotee to convey the health message. Similarly, for Mix2 the instruction to use literal pictures (H style) of happy African cocoa plantation workers (O image) also resulted in a different image of an ethnic worker. Note that the diagonal cut on the Mix2 package is identical to that on the H package, where it was used to suggest the speed of the athletes. For the inconsistent yogurt packages, the images the designer used were mostly equivalent but different from those used for the consistent packages, except for the head of the cow in E and Mix1, which are identical.

Due to the designer's freedom in the use of images and stylistic elements, the experimental manipulations may lack the academic rigor necessary to obtain the evidence for demonstrating causal effects, as this opens up the possibility for alternative explanations. Nonetheless, we

think that our experimental approach is valuable because it tries to disentangle different communication mediums and offers a first attempt to separate their impact on consumer perception, despite their intricate connectedness in realistic packages. Note that in real-life situations, designers could have even more freedom, as they could change not only text, images, and stylistic elements, but also additional dimensions, such as package shape, size, and material. On the other hand, requirements from the product brand can limit this creative freedom.

Alternatively, using realistic packages may call for different ways of analyzing such packages as the different elements will become more intricately connected. For instance, Ares et al. (2011) made a semiotic analysis of the non-verbal characteristics of the labels of yogurt packages and used the outcomes to create five model labels combining some of the representative elements of the main messages present in the surveyed markets. The semiotic analysis shows the richness of consumer associations, and also indicates that the relationships between the different elements of a package are important to consider (e.g., color use, relative positioning and sizes). For instance, the authors provide the following account for the differences between two packages, both using green, blue and white: 'Green is commonly used to express healthiness, freshness, naturalness and life […]. Blue refers to calm, relaxation, safety, freshness, cleanness and peace, particularly in [the case of Yogurt 1] in which it was used in the representation of the sky […]; whereas white suggests purity, tranquility and cleanness. […]. [In Yogurt 2] green was only used in the typography, which tried to suggest that the naturalness of the product was not the central idea that the label is trying to convey. The main colors were white, related to purity and cleanness, and sky blue, stressing the freshness and purity of the product. […] An interesting feature of this label was that sky blue was used in the mountains and that white was used in the sky. This might be associated with the fact that the designer wanted to create an imaginary world, presenting the product as different, dreamy and modern […].' (Ares et al., 2011, p. 693). Such considerations can improve understanding of consumer thought processes that designers need to take into account. Consumer evaluations of the model labels using a word association task showed that the key messages were well understood and matched the outcomes of the semiotic analysis, but also revealed cultural differences for some of the minor aspects between the two sample populations in Spain and Uruguay.

In a similar vein, Celhay, Cheng, Masson, and Li (2020) provide a semiotic analysis of eight fictional wine labels. In this case, the labels contained verbal messages in French, but because the participants were all Chinese, they could not read the messages and thus based their evaluations on the graphic design of the labels. To really understand the full complexity of food packages, however, we also need to consider the interplay between graphic and textual messages. Possibly, we can learn here from semiotic research into the relationships between text and illustrations in books (Martinec & Salway, 2005) or research into graphic novels and comic books, where there is a close relationship between the content of an image and the accompanying text (Cohn, Taylor, & Pederson, 2017). Furthermore, the power of text and image contents in evoking public responses to social media posts (Rietveld, van Dolen, Mazloom, & Worring, 2020) may provide insights in the engaging qualities of different design elements.

4.4. Study limitations and suggestions for future research

In our study, the consistent packages did not always rate highest on their target dimension, even though they were designed to deliver a single message through the different manipulated mediums. For the orange juice and yogurt packages, for instance, the healthiness ratings were similar for the H, E, and O packages. Possibly, the product category is partly responsible for the perceptions of specific attributes and not the packaging. Orange juice and yogurt can be considered classic prototypes of relatively healthy products and consumers may not need support from the product packaging to infer this. This can create a ceiling effect, in case the category is considered so healthy that there is not much room for improvement due to cues on the packaging. Alternatively, the packages that we designed to communicate organic production, animal-friendliness, artisanal production, and a refreshing taste may all have evoked associations of healthiness. Respondents may have intricately linked values related to nature, animal life, farm life, and sensory pleasure to the perception of healthiness (e.g., Hoek et al., 2017). Some authors have referred to this effect as a health halo, for instance, when a firm's corporate social responsibility activities led to inferences about the healthiness of the product (e.g., underestimation of calories) (Peloza, Ye, & Montford, 2015). Furthermore, participants seem to think that not only yogurt produced in an artisanal way, but also the one produced in an animal-friendly way is produced on a small-scale farm. While these results support previous findings showing that consumers associate various domains of sustainability that are not necessarily logically connected (e.g., Basiago, 1998; Pullman, Maloni, & Carter, 2009; Sanders, 2013), these findings interfere with the goal of our study to independently manipulate various domains of product perception. Nonetheless, the dummy regression analyses comparing all six packages have been able to single out and demonstrate some of the effects we were interested in.

The creation of attractive H packages proved challenging. Images of human organs, bacteria, chemical formulas, or abstract representations of protection mechanisms may all evoke associations of scientific experimentation and high-tech innovations that contradict the romantic associations of authentic, small-scale, natural food production and cozy, sociable family dinners (Janich, 2017). In future research, it might be interesting to investigate the associations of such imagery in more depth, including the emotions that they might elicit. Moreover, it would be interesting to see how the degree of realism in such images will affect the intensity of such connotations and the corresponding emotional associations (Lemke et al., 2021).

Our instruction to create packages that communicated three messages through different mediums sometimes severely limited the design options. This became evident for the Mix3 designs, which tended to obtain the lowest ratings on aesthetics and convincingness (Table 3). Probably, combining an environmental style (e.g., the color green) with healthy imagery made it hard to create an attractive and believable package. Only for the muesli bar wrapper it worked relatively well, because in this case the green matched the image of joggers in a parc.

Because we gave the designer the freedom to develop design elements to communicate the various benefits and we did not strictly control these manipulations, the quality of individual elements may have affected the outcomes of our study. For instance, if the designer comes across a great photo that really captures the emotion (e.g., muesli bar Mix2 in Fig. 3) or a font that can make a sensation almost tangible (e.g., orange juice O in Fig. 2), it will surely enhance the impact of these design features. Therefore, designers' skills, their ability to follow the design brief and sometimes their luck in finding the best elements, along with their ability to integrate the elements in a successful package and to make the best choices, are all likely to affect the results of the empirical study. Hence, the cooperation with a skilled designer is essential for conducting these studies.

In controlled experiments, variables also need to be operationalized, for instance by choosing a picture of an athlete as an image of a healthy person. Our experiment is different because sometimes our designer made the choice to use another image in a different condition. Therefore, the outcomes of statistical tests must be interpreted not only by considering the manipulated variables, but also in light of how the designer has operationalized them in the different conditions, as the use of multiple images allows for alternative explanations. Because our experiment deviates from the classical rules in these cases, this also creates freedom of interpretation for the researcher and a dilemma arises: If the rules of experimental set-up and the conditions for statistical testing are not met, how can the outcomes be interpreted? Following strict rules of quantitative research would dismiss the whole

study, but nonetheless the outcomes seem to provide interesting leads with potentially important implications for design practice. How can we decide which conclusions are appropriate if the usual procedures do not apply? Can we rely on the experience of the researcher to make the right decision, just as we rely on the skills of the experienced designer? Or is it possible to derive formal criteria and procedures to be followed in this type of research? In the current paper, we have tried to circumvent the issue by using more cautious interpretations of the outcomes of statistical tests and rephrasing the outcomes as suggestions, rather than definitive conclusions. An alternative could be to use more conservative α-levels for testing, but then we need a set of arguments to help estimate the factor by which α should be decreased. For instance, in our study all the tests in Tables 2–4 were planned beforehand and thus were not suggested by the data, even though we did not predict the direction of these effects. In addition, since one of our goals was to find clues as to which of the communication mediums were more suitable for conveying certain information than others, it would be a shame if we missed some of these clues because we applied too strict criteria.

It would be interesting to establish which factors determine how a benefit can be communicated optimally in future research. Possibly, the extent to which messages activate cognitive reasoning versus emotional involvement with the different benefits plays a role in determining the suitability of the different mediums. For themes activating consumers' emotional engagement, communication mediums that elicit the desired emotions are likely to be more successful than for benefits that are considered relevant but do not evoke such an affective connection. This could explain why experiential benefits for which subjective feelings are important, such as sensory appeal, are supported better by imagery or stylistic elements than by textual messages. On the other hand, consumers who are well-informed or show a factual interest in specific topics may appreciate objective information and may thus prefer a simple text.

Although we designed the study with a Dutch-German team, we tested our designs in a population of North American participants. Consequently, we cannot be sure that all the design elements were interpreted as we intended, because of potential cultural differences in design conventions (Festila & Chrysochou, 2018). For instance, the Boerenbont pattern that we used to communicate artisanal farm life on the yogurt packages is typically Dutch and may not have evoked the intended associations among the North American participants. Nonetheless, we did not observe any clear examples of misunderstandings in the outcomes of the study.

Please note that in some cases we used stylistic elements and images that were possibly based on a simplistic, stereotypical understanding of certain cultures and manufacturing processes. For example, as part of the O muesli bar design, we used patterns and images that referenced an African culture. It would require further investigations to determine if the chosen patterns and colors are appropriate representations for nations that produce cacao in a slave-free manner. Using symbols and colors with strong symbolic meaning for commercial purposes has been criticized as cultural appropriation and being culturally insensitive when symbols are used and adjusted without acknowledgement of their true meaning and intended context of use (Shand, 2002). Furthermore, using images and decorative elements with strong symbolic meaning to express a certain sense of authenticity that does not represent the actual production environment can mislead consumers (Barnes, 2017).

The Qualtrics software that we used makes it possible to fill out questionnaires on various standalone and mobile devices. It automatically reduces image sizes to improve viewing conditions. As a result, on a laptop the orange juice packages are displayed quite small compared to the muesli bar packages and these images cannot be altered, whereas on a smartphone the images can be enlarged to any wanted size. Hence, in some conditions a portion of the respondents may have missed some packaging details, but we are unsure for how many respondents this could be the case.

In our study we have focused solely on graphic design elements, but design practice also needs to consider how the material and shape of the packaging can influence the perception of the product it contains (Vermeir & Roose, 2020). For example, food items wrapped in materials that are biodegradable and associated with healthiness (cardboard) are perceived as healthier than food items wrapped in material perceived as unhealthy (plastic) (Fenko, Kroese, & Karreman, 2017). We have not explicitly specified the material as part of the style category in the current study. However, including aspects such as packaging texture, the level of transparency and gloss could significantly influence the perception of the product and would be an interesting variable for future studies (e.g., Schifferstein, Fenko, Desmet, Labbe, & Martin, 2013). Similarly, packaging shapes may be used to convey certain messages about a food product (e.g., Becker, van Rompay, Schifferstein, & Galetzka, 2011; Velasco, Woods, Petit, Cheok, & Spence, 2016). Therefore, it may be of interest to also test the effects of adjusting shapes of (well-known) food products, to understand how this influences the perception of the product.

4.5. Practical implications

Ankiel, Sojkin, and Grzybowska-Brzezinska (2020) have shown that in the process of purchasing food products consumers perceive and analyze only selected components of the information and cues provided on food packaging, but that excessive optional information can introduce information noise. Our participants did not find the inconsistent packages more confusing than the consistent ones. This may indicate that people are used to receiving multiple messages from a packaging design. In fact, in our study packages contained maximum three messages that were all kept fairly simple (no long sentences). Hence, they probably were simpler than many packages that can be found in supermarkets nowadays. Also, because people find many of the domains that we used related (e.g., health, nature and social equality all seem to be closely connected to sustainability), they may not have perceived any psychological inconsistencies.

Although the evaluations of our food packages suggest that it is no problem for consumers to perceive multiple messages on a package, the way these messages are communicated is likely to determine their effects. The outcomes of our study suggest that some mediums were effective in conveying a specific message, whereas others had no effect or even an opposite effect. For instance, to communicate freshness the typeface resembling ice cubes appeared effective, whereas using a verbal claim that the juice was refreshing tended to produce the opposite effect. Possibly, if a brand has to say explicitly that it is refreshing, consumers could lose confidence in the brand, because they will perceive it anyway when they taste it. Therefore, an implicit message communicated by the typeface may be perceived as more trustworthy. On the other hand, a verbal claim that the product has been produced in an environment-friendly or animal-friendly manner cannot be verified by consumers. Therefore, they may place more trust in the claim when it is explicitly written down, more than when they must derive it from an image that can be interpreted in multiple ways, and definitely more than when it is communicated implicitly by stylistic elements. When it comes to communicating about long-term health effects, our study suggests that consumers will also place the most confidence in verbal messages. In fact, designers should be careful when using health-related images: Although packages displaying athletes rated high on expected healthiness, the dummy regressions for the health effects all generated negative coefficients for the images, suggesting that most health-related images decreased the perceived healthiness of the product. Whether the effects we found were universal or specific to the stimuli we used to operationalize certain benefits needs to be confirmed in subsequent studies.

It is particularly relevant for marketing practice that we found that environmental stylistic features tended to decrease packaging attractiveness. Because the importance of sustainability issues among policy makers and consumers has increased in recent years and is likely to continue to increase in the future, it is important that designers find a

way to communicate sustainability issues in a positive way, to promote the use of products that support ecological production. Taking the results of Table 4 together would suggest that the optimal food package could contain verbal health claims and environmental claims, display images of happy workers and perhaps natural scenes of fruits or vegetables growing on plants, supplemented with typefaces or other stylistic elements that support the sensory properties of the product. Future research with new package designs for other product types should help determine whether these effects are consistent and reliable.

In this research paper, we have explicitly considered the designer's dilemmas and choices during the creation of packaging design and their effect on the interpretation of the data of a consumer evaluation study. This brings together creative considerations and limitations with the intended and unintended effects of such decisions. Together this paints a rich picture of some of the issues that come up while choosing a picture, making it acceptable for commercial use, applying style elements, while trying to address the limitations set by a client or, in this case, the researchers. We hope that some of these considerations will spark new ideas for setting up research that involves realistic designer decision making.

CRediT authorship contribution statement

Hendrik N.J. Schifferstein: Conceptualization, Methodology, Investigation, Data curation, Formal analysis , Project administration, Funding acquisition, Writing – original draft, Writing – review & editing. **Mailin Lemke:** Methodology, Visualization, Writing – original draft, Writing – review & editing. **Alie de Boer:** Methodology, Writing – original draft, Writing – review & editing.

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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Appendix A. Supplementary data

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