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Consumer response to packaging design: The role of packaging materials and graphics in sustainability perceptions and product evaluations

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ABSTRACT

Building on theories of cue utilization, this paper investigates whether and how packaging sustainability influences consumer perceptions, inferences and attitudes towards packaged products. A framework is tested in an empirical study among 249 students using soup products varying in packaging material and graphics. The findings show that (packaging) sustainability is a highly salient association but is only moderately important for consumer attitudes. A comparison between consumer judgments and life-cycle assessment indicates that consumers rely on misleading, inaccurate lay beliefs to judge packaging sustainability and are therefore susceptible to making ineffective environmental decisions. The research also demonstrates the power of packaging in shaping perceptions of food products. Particularly, it shows that changes in actual environmental impacts (by altering packaging materials) affect not only sustainability perceptions but also several other benefits, such as perceived taste and quality. At the same time, consumers' sustainability assessments are also highly influenced by mere graphical packaging cues that have no obvious actual sustainability consequences.

1. Introduction

Packaging is a pervasive element of modern consumption that provides a wide range of functionalities and consumer benefits. The role of packaging is perhaps of greatest importance in consumer packaged good (CPG) markets, which often strongly rely on packaging elements to maintain product quality, prevent product losses, facilitate transportation and storage, and provide marketplace differentiation. In the current practice, packaging is designed to outlast its contents and, after usage, often becomes redundant. Given the high frequency of CPG purchase and disposal, this adds to an increasing environmental burden, which contributes to global warming, raw material depletion, acidification and energy consumption (Bovea et al., 2006). Consequently, incessant packaging waste has received major attention from policy-makers, environmental lobbyists, consumers and the packaging industry alike.

Because the concept of sustainability seems to be increasingly important to consumers (Bemporad et al., 2012; UNEP, 2005), they could be important actors in the trend toward more-sustainable packaging. However, getting consumers to choose sustainably packaged products is challenging. First, although knowledge on the environmental impacts of packaging is well developed in the form of life-cycle assessments (LCAs), consumers have limited knowledge about packaging sustainability. They therefore rely on their own lay beliefs and may not spontaneously include sustainability in their purchase decisions (Lindh et al., 2016a; Van Dam, 1996). Locating and understanding discrepancies between LCA outcomes and consumer beliefs is important, as these discrepancies may be a threat to sustainable development. Second, consumers' limited knowledge does not withhold them from forming opinions and making purchase decisions, which are often based on simple inferential cue utilization processes. In this sense, even consumers with sustainable motivations could be misled (by their own beliefs)

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and end up making (environmentally) ineffective decisions. Third, sustainability is only one of many aspects that consumers may integrate into their decision-making. Prior research attests to the power of packaging in shaping consumer product expectations, evaluations and experiences (Orth and Malkewitz, 2008), but comparatively little of this research has been performed in light of sustainable packaging. This is important because sustainable packaging options may be perceived differently in other aspects (e.g., price or quality), which could hinder the product from being chosen.

Sustainable packaging can be defined as packaging that has a comparatively low environmental impact as assessed by life-cycle assessment models (Glavič and Lukman, 2007). From a consumer-perspective, sustainable packaging can be considered "a packaging design that evokes explicitly or implicitly the eco-friendliness of the packaging" (Magnier and Crié, 2015). In this consumer view, packaging provides the relevant cues from which consumers infer sustainability using their stored subjective knowledge. Packaging design involves a combination of structural (e.g., materials), graphical and verbal (informational) elements. Packaging materials are the main contributor to direct (objective) environmental impacts, and they signal sustainability (Lindh et al., 2016b). Graphics and colours on packaging may also be used to signal sustainability, such as green colouring being implicitly associated with sustainability (Hoogland et al., 2007; Magnier and Schoormans, 2015; Pancer et al., 2015). In addition, verbal features can be used to communicate sustainability explicitly, for instance, through labelling, which has been extensively studied in prior research (e.g., Magnier and Schoormans, 2015; Pancer et al., 2015).

This paper examines the implicit influences of both the structural elements (materials) and graphical design of packaging on consumer perceptions of sustainability and their effects on product attitudes. This is done by elaborating a cue-utilization framework within the context of (sustainable) packaging that details the different steps in consumer perception and evaluation of a set of packaging designs. Additionally, consumers' sustainability perceptions are compared with life-cycle assessment outcomes.

2. Literature review

2.1. Consumer response to sustainable packaging

Prior research on consumer response to sustainable packaging can be classified into three areas of research: (1) general attitudinal models, (2) holistic approaches focussing on consumer perceptions and semiotics, and (3) analytical approaches testing the effects of specific packaging design cues. Research building on general attitude models (typically the Theory of Planned Behaviour, TPB) explains consumers' choice for sustainable packaging from psychological factors such as environmental awareness, knowledge and concern, amongst other TPB factors, such as perceived behavioural control and subjective norms (Martinho et al., 2015; Prakash and Pathak, 2017; Van Birgelen et al.,, 2009). These studies focus on the general propensity of consumers to engage in the purchase (and disposal) of environmentally friendly packaging, but they often lack detailed information on how specific packaging design elements can affect behaviour. Furthermore, because sustainability aspects are typically explicitly prompted from participants, these studies also fail to address the salience of packaging sustainability to consumers.

The second line of research includes studies following a holistic approach. These studies focus on the concept of packaging as a whole and generally do not provide or independently consider specific characteristics of the packaging (Magnier and Crié, 2015). For example, Orth and Malkewitz (2008) state that "the overall effect of the package comes not from any individual element but rather from the gestalt of all elements working together as a holistic design". These studies focus on how consumers construe and convey meaning to the concept of sustainable packaging and highlight that structural, graphical and verbal design cues of packaging may signal packaging sustainability in a variety of ways (Lindh et al., 2016a,b; Magnier and Crié, 2015; Nordin and Selke, 2010). Findings suggest that consumers strongly rely on material/structural cues to form judgments on packaging sustainability (Lindh et al., 2016a,b; Magnier and Crié, 2015; Van Dam, 1996), but the studies do not explain how (specific) packaging materials can lead to different consumer responses. Understanding this is important, as consumers' packaging material choices are key in decreasing the actual environmental burden of packaging. This stream of sustainable packaging research also shows that consumers are not very knowledgeable about the concept of (packaging) sustainability and that their terminology and perceptions are often inconsistent (Lindh et al., 2016a,b; Magnier and Crié, 2015; Nordin and Selke, 2010; Scott and Vigar-Ellis, 2014). For example, survey studies attest that many consumers are unable to identify sustainable packaging and/or lack insight as to what it should entail (Lindh et al., 2016a,b; Nordin and Selke, 2010). Consequently, consumers appear to over-emphasize some environmental aspects (e.g., recyclability), whilst ignoring others (e.g., transport and production costs).

In the third line of research, there are numerous packaging studies following a more atomistic ('piecemeal') and analytical approach. These studies isolate specific packaging cues such as transparency (Deng and Srinivasan, 2013), single vs. multi-serve formats (Ilyuk and Block, 2016), shape/volume (Folkes and Matta, 2004) and graphical and verbal features such as colours and labels (Celhay and Trinquecoste, 2015; Magnier and Schoormans, 2015), and they estimate their effects on purchase criteria, choice and/or consumption. This is important because at the point-of-purchase, consumers are confronted with (and purchase) a packaged product. That is, consumers may purchase canned tomato soup, in which case the can is the packaging and tomato soup is the product contained within. The influence of packaging on product (benefit) evaluations is thus highly relevant to explaining actual purchase decisions. The role of packaging design is, for example, demonstrated in its effects on aesthetic appreciation (Celhay and Trinquecoste, 2015), price and quality expectations (Orth et al., 2010), taste impressions (Becker et al., 2011; Van Rompay et al., 2016), naturalness (Binninger, 2015) and health perceptions (Van Rompay et al., 2016). Only a few studies in this line of research explicitly investigate the role of packaging sustainability. These studies suggest that the environmental aspects of packaging design play a significant role in consumers' choice behaviours (Rokka and Uusitalo, 2008) and purchase intentions (Magnier and Schoormans, 2015; Pancer et al., 2015; Magnier et al., 2016). Additionally, the results of these studies suggest that perceptions of sustainability are related to inferences on other benefits, such as the product's taste or price. These associations have garnered increasing attention in the sustainable marketing literature (Lin, 2012; Luchs et al., 2010) and could be an important factor in understanding consumer preferences for more-sustainable alternatives. Generally, these analytical studies have focussed on verbal and graphical cues signalling sustainability (Magnier and Schoormans, 2015; Pancer et al., 2015; Spack et al., 2012); a more comprehensive understanding of material effects is still lacking.

Bringing the three lines of research together, it is likely that consumers' attitudes (and, by extent, purchase behaviours) depend strongly on both holistic and atomistic (analytical) processing of packaging designs (Bloch, 1995). Integrating these insights, the following contributions of the current research are highlighted.

Since consumer attitudes rely on perceptually salient features, the first contribution is to examine whether sustainability is actually salient in consumers' perceptions of packaging designs relative to other perceptions. For this, the current study generates insight into consumers' intuitive spontaneous associations with packaging without prompting them. Second, prior literature has identified that a gap exists between consumers' subjective judgments of sustainability and the 'objective' environmental impact, but thus far, these discrepancies have hardly been specified. The current research assesses whether and where discrepancies occur between consumers' subjective judgments of sustainability and the 'objective' environmental impact assessed through LCA. Third, using varying packaging designs (and keeping the product constant), consumers' packaging-based perceptions are linked to specific benefits of the packaged product (e.g., taste, quality, price perceptions). In doing so, the importance of sustainability is investigated relative to other benefits.

3. Conceptual framework

3.1. Benefits and consumer attitudes

Many fundamental models of consumer behaviour posit that consumers purchase products because they possess benefits that are connected to consumers' needs and desires (Steenkamp, 1990; Zeithaml, 1988; Grunert, 2005). Choice is considered as being derived from consumers' attitudes towards the product, which in turn are based on an evaluative integration of benefits ascribed to the product by consumers (Fazio, 2007; Ajzen, 1991). Although benefits can be highly diverse and dependent on the product category, research in the food domain suggests that quality, health, sensory appeal (e.g., taste), naturalness, price, and convenience, as well as social benefits such as sustainability, are generally important to consumers (Furst et al., 1996; Steptoe et al., 1995). In terms of packaging, a large part of consumer response is a function of which benefits the packaging is perceived to provide, in which two possible effects are discernible. First, packaging may directly provide a benefit, for example, by providing convenience through portability. Second, packaging may more indirectly signal product benefits through consumer inferences. For example, glass may be associated with high quality, or the graphics may be designed to communicate luxury (Celhay and Trinquecoste, 2015; Orth and Malkewitz, 2008).

3.2. Cue utilization process & packaging

Consumers often need to infer benefits they cannot reliably assess when making a purchase (e.g., taste) or that are difficult to assess even after consumption (e.g., sustainability). Since packaging is often designed to generate consumer impressions and, for example, consumers infer product taste from the packaging design (Becker et al., 2011), consumers rely on a wide range of beliefs and associations to form judgments. This process can be described as a cue utilization process (Olson and Jacoby, 1972). In the classical view of cue utilization theory, consumers ascertain and evaluate multiple cues (e.g., packaging colour) based on the cues' predictive and confidence values (Olson and Jacoby, 1972). The predictive value of cues is the degree to which cues are perceived to be associated with specific benefits (e.g., sustainability or taste), while the confidence value is the degree to which consumers are confident in making accurate judgments based on these available cues. Before such an inferential process is possible, the packaging cues must first be acquired and interpreted. These subjective *cue perceptions* can be seen as a function of the objective features "as designed" and consumers' idiosyncratic perceptions and assessments thereof (Steenkamp, 1990).

In most purchase contexts, cues are plentiful and consumers' attention is limited (Higgins, 1996). Hence, not all cues are readily perceived, and only those cues that are sufficiently salient lead to benefit inferences. Cue salience is regarded as the propensity of the cues to be noticed or come to mind (Romaniuk and Sharp, 2004). Since consumers rely on salient cue perceptions, they may be unable to (correctly) perceive certain features, may have varying and possibly conflicting perceptions of the same design, and may vary in which cues are salient to them in the first place. Although intrinsic (product) cues often have higher confidence values than extrinsic (packaging) cues, in purchase environments, these intrinsic cues may be difficult to assess. Consumers, then, place greater emphasis on (extrinsic) packaging cues (Richardson, 1994; Underwood et al., 2001; Zeithaml, 1988).

Packaging can be viewed as consisting of an array of structural, graphical and verbal design features that may serve as consumer cues (Magnier and Crié, 2015; Rettie and Brewer, 2000; Underwood, 2003). Structural features consist of the material type, shape, size, weight and texture, while graphic features include the colours, imagery, graphics and typewriting (Magnier and Crié, 2015; Magnier and Schoormans, 2015; Underwood, 2003). Verbal features consist of explicit textual information available on the package (Magnier and Crié, 2015; Rettie and Brewer, 2000; Van Rompay and Veltkamp, 2014) and often relate to information about the product contained within (e.g., taste, nutritional contents, best by date, brand name). Packaging may play a large role in implicitly cueing sustainability, in particular because packaging material directly affects the environment (e.g., due to production and energy consumption), but also because the packaging provides graphical cues for sustainability inference through colours, labels, fonts, etc. (Magnier and Schoormans, 2015; Pancer et al., 2015). Such cues may lead consumers to infer that the packaging itself is more sustainable, but these cues may also affect the perceptions of the product contained within. Furthermore, although graphical elements have no (or minimal) direct effects on the environmental burden in terms of LCA, consumers may still rely on these cues in their perception of sustainability.

3.3. Model integration

Integrating the different concepts of the literature review, a framework is proposed (Fig. 1) that contains three phases. Phase one considers the cue perception process of packaging wherein salient cues are acquired and interpreted by consumers as "cue perceptions". Phase two considers how these packaging-based cue perceptions lead to benefit inferences of the product, such as taste, quality and price perceptions. Phase three examines how these benefits contribute to product attitudes.

4. Method

4.1. Consumer perceptions, inferences and attitudes: empirical study

An empirical study of cue perception elicitation was conducted based on the free choice profiling method (A. A. Williams and Langron, 1984; Steenkamp et al., 1994). The elicitation methodology requires respondents to express, in their own words, perceived differences based on packaging designs, without being exposed to researcher items. This makes the method suitable for exploring consumer perceptions without imposing pre-defined constructs. The elicitation procedure was followed up by collecting consumer evaluations for each packaging.

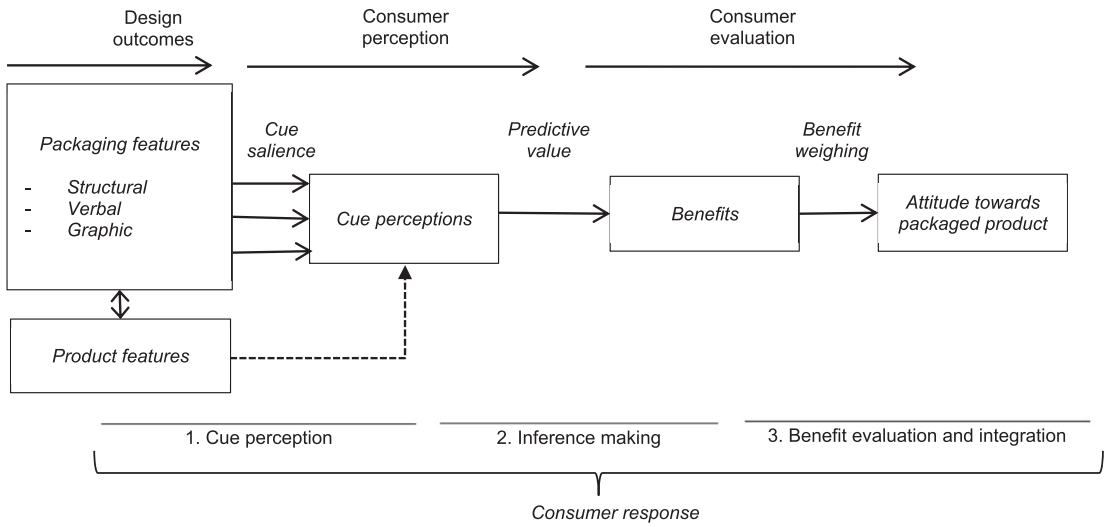

Fig. 1. Conceptual framework.

4.2. Respondents and stimuli

Respondents were 249 Dutch university students (69% female, $M_{age} = 20.4$). The stimuli consisted of 14 tomato soup products varying in packaging design (7 structural designs and 2 graphical schemes), presented as pictures (Appendix 1). The Unox brand was chosen as a familiar national soup brand that does not occupy specific market niches. Tomato soups were used because these are available in a wide range of packaging options with different environmental impacts. Common structural designs were chosen: glass jar, bioplastic pot, liquid carton, dry carton sachet, plastic pouch, mixed material pouch (plastic with carton wrapping) and a can. The two graphic schemes differed in colours, graphics, typography and imagery. One graphic scheme was designed to be "conventional-looking", the other as "sustainable-looking" (cf. Magnier and Schoormans, 2015), but this was not explicitly communicated to respondents. This was done to create a distinction between graphical designs often used for sustainable or "green" products and more-standard tomato soup options. By extent, this allows a test of whether consumers are affected by cues that are generally irrelevant for LCA (i.e., both graphical designs are equivalent in terms of LCA impacts). On-package verbal information (e.g., brand and product name/type) was kept constant across designs, with the exceptions of the bioplastic pot and dry carton, which were respectively labelled to indicate that the pot material was bioplastic and that the carton contained multiple packs within, since otherwise this would not be discernible.

4.3. Procedure

The study was carried out in a lab setting in a self-administrative manner (behind a computer) using Qualtrics software. Prior to the study, the procedure was tested on a small sample ($n = 7$) to check for clarity and errors. Minor textual changes were made, and image sizes were maximized. Respondents proceeded through three stages. The first stage was cue perception elicitation using triadic sorting. Respondents were presented with seven randomly generated sets of three tomato soups (triads) selected from the total pool of 14 images. A selection of seven triads seemed reasonable based on elicitation research with similar (amounts of) stimuli (Ares and Deliza, 2010; Gelici-Zeko et al., 2012). Respondents were instructed to sort the packaged soups in such a way that two were similar and different from the third (cf. Bech-Larsen and Nielsen, 1999; Kelly, 1955). They were asked: *"In which way are two of these products alike and different from the third product? Think of the positive and negative characteristics upon which you would base your choice during purchase and provide a description of this"*.

For each triad, respondents wrote down two cue perceptions in a short phrase or word: first, how they perceived the two similar products to be alike, and second, how the third was different. This generated a series of dichotomous cue perceptions. Respondents first started with an unrelated warm-up triad before continuing.

In the second stage, respondents were presented with their own descriptions (i.e., cue perceptions) and were asked to indicate which of these described each of the 14 tomato soup products in a "check all that apply" (CATA) format (Coombs, 1964). The third stage asked respondents to score all tomato soup products on eight benefits based on the Food Choice Questionnaire (Steptoe et al., 1995). The benefit items were (translated from Dutch): "This product is/has: convenient/healthy/natural/cheap/sustainable/sustainably packaged/good taste/excellent quality", using the anchors "disagree completely" and "agree completely". The order was randomized. Attitudes towards the packaged product were measured by asking "What is your overall evaluation of this product?", using "bad" and "good" as scale anchors. All items were measured using an unnumbered 0 to 100 slider scale.

4.4. Life-cycle assessment (LCA) data

Additionally, LCA data were obtained to facilitate a comparison with consumer judgments. The environmental impacts for cans, plastic pouches, liquid cartons and glass jars were based on measurements of the packaging composition, applicable for the Dutch context. For the bioplastics and dry sachet, estimates were made based on single measurements and the literature (Braskem, 2014; Kuraray, 2012; Ziem et al., 2013). The soup product itself and its preparation were excluded from LCA. The life cycle inventory data were obtained from the ecoinvent v3.01 database (ecoinvent, 2013). When inventory data for the packaging were missing, approximations were used. The ReCiPe endpoints method was used for analysis, as it is a commonly accepted LCA method (Goedkoop et al., 2013). Further details on LCA specifications can be found in the supplementary materials.

4.5. Data analysis

Analyses were carried out with the aim to examine each phase outlined in the conceptual framework. The first model phase contained multiple analyses. First, content analysis was conducted (1) to give an indication of the variety and frequency (i.e., salience) of the constructs respondents mentioned, (2) to facilitate the interpretation of the following cluster analysis, and (3) to facilitate grouping of cue perceptions for regression analysis. Coding followed an inductive procedure (using a single coder), with the aim to group conceptually similar cue perceptions into general content categories. Coding followed two iterations. First, individual cue perceptions were coded into 83 categories. Second, categories with a similar meaning were grouped once more (e.g., "environmentally friendly" and "degradable materials" would become part of the overlapping "sustainability" category) into 28 final content categories. Before proceeding further, data were cleaned by first removing cue perceptions that were not checked at all during the CATA-task, leaving 3224 (out of 3500 total) cue perceptions. Another 145 cue perceptions were scattered over a set of small uninformative content categories and/or were difficult to classify, and were thus excluded from further analysis.

Second, hierarchical cluster analysis (HCA) was conducted using the CATA data. To interpret the clusters, proportions were calculated to measure the extent to which the 14 packaged products were described by the clusters. Third, content categories and clusters were cross-tabulated in order to (a) interpret the clusters, (b) analyse how cue perceptions are associated with specific packaging designs (e.g., "sustainability" with "glass pot"), and (c) investigate the degree of consensus in terms of how cue perceptions are ascribed to packaging designs. Finally, the LCA-consumer comparison was conducted. For this, respondents' ratings of packaging sustainability per material type (averaged over the two graphical schemes) were reversed (i.e., higher outcome equals lower degree of sustainability) to equalize them with LCA.

The second phase of the conceptual framework considers how the cue perceptions of the previous phase are related to tomato soup product benefits. To analyse this, content categories from phase one were used as predictors for each benefit in a series of multilevel regression analyses. Further, repeated measures ANOVAs were conducted to analyse whether consumer benefits are affected primarily by packaging materials, graphics, or both. The final phase of the framework encompasses the integration of benefits into an overall attitude assessment. To investigate this, multilevel regression analysis of attitudes on the benefit dimensions was conducted.

5. Results

5.1. Packaging cue perception

5.1.1. Spontaneous cue perceptions: what did respondents say?

To indicate the variety and salience of cue perceptions as indicated by the respondents, the content analysis categorized 3224 cue perceptions into 28 content categories, displayed in the rows of Table 1 (final column indicates content category sizes). Content categories were divided into abstract and concrete cue perceptions. Abstract cue perceptions were the perceived consequences of packaging features (e.g., 'tastiness', 'attractiveness'). Concrete cues were those that relate specifically to packaging features such as its materials, shapes, transparency, or packaging type. The results indicated that sustainability appeared highly salient (293 cue perceptions), second only to convenience (382 cue perceptions). Novelty/conventionalism (263 cue perceptions) and quality (189 cue perceptions) were the third and fourth most commonly mentioned. These results showed that respondents primarily mentioned convenience and sustainability aspects as a result of changes in packaging.

5.1.2. Clusters of meaning: associating packaging-based cue perceptions with tomato soups

To uncover how respondents' cue perceptions were linked to the fourteen tomato soups, cluster analysis was conducted. Cluster retention indices provided by the R-package NbClust (Charrad et al., 2014) suggested a 21-cluster solution; hence, this solution was chosen. The Jaccard similarity index was used, which ensures that only the presence of CATA "checks" contribute to similarity (and that similarity in absent checks does not contribute to the clustering). Eight clusters of meaning (representing 90% of the data) were retained. Table 2 displays the most-common cue perceptions per cluster, and proportions display the extent to which the given packaging was described by a cluster. The results show that a consistent distinction can be made between the two graphic designs. The conventional-looking scheme was described as modern and familiar (cluster one), whereas the sustainable-looking scheme was described more as traditional (cluster four). Cluster two seemed to describe quality and, to a lesser extent, transparent, rounded and rigid packages, and it has considerable proportions on the bioplastic pots and cans. Cluster three was related to both pouches and dry cartons, and it described material flexibility, worse protective characteristics and lower package quality. Cluster five described cartons and rectangular shapes as related to convenience and (low-) sustainability aspects. Cluster six distinguished the bioplastic pots from other packages and contained a more concentrated amount of sustainability cue perceptions. Cluster seven described cans in relation to opacity and inconvenience as well as round shape and rigidness (similar to cluster two). Cluster eight included the transparent plastics. Overall, three important distinctions became apparent from clustering: (1) holistic impressions of modernity/familiarity vs. traditional design obtained from the graphics (e.g., Orth and Malkewitz, 2008); (2) (protective) quality, where rigid packaging is mostly associated with higher protective quality, while flexible packaging is worse; and (3) sustainability, with bioplastic as the most sustainable and dry carton sachets as the least sustainable.

5.1.3. Comparing content categories and clusters

Table 1 shows the distributions of cue perceptions (in percentages) across the different clusters. Based on these distributions, the Herfindahl index (Tirole, 1989; see also Simonson and Winer, 1992) was calculated to indicate consumer consensus among cue perceptions by measuring the degree of concentration of each of 28 content categories across the clusters. A Herfindahl index (*HI*) close to 1 indicates a highly concentrated distribution of cue perceptions over clusters, while lower scores indicate more dispersion (i.e., less consensus) among the cue perceptions' assignment to clusters.

Notably, the *HI* for sustainability cue perceptions was low ($HI = 0.16$), compared to the other salient cue perceptions: convenience ($HI = 0.22$), novelty ($HI = 0.28$) and quality ($HI = 0.24$). This means that sustainability perceptions were relatively highly dispersed over multiple clusters. Furthermore, the Herfindahl index was significantly lower ($F(1,26) = 16.18$, $p < 0.001$) for the abstract cue perception categories ($M = 0.23$) than for the concrete categories ($M = 0.54$). This is likely due to the more subjective nature of the abstract categories. Overall, these results indicate that respondents used different sustainability criteria (e.g., recyclability vs. degradable materials) and/or viewed the same packaging designs differently in regard to how sustainable they are. Although a lower level of agreement is expected for more-abstract concepts, the low *HI* seems exacerbated for the sustainability cue perceptions. Conclusively, respondents on the whole appear to rely on

Table 1
Distribution of cue perception content categories among clusters.

	C1	C2	C3	C4	C5	C6	C7	C8	C9-21	*HI*	*n*
Abstract cue perceptions											1848
Convenient	32%	26%	18%	1%	13%	1%	2%	3%	5%	0.22	382
Sustainable	23%	23%	11%	6%	7%	18%	1%	2%	10%	0.16	293
Novel, modern	32%	6%	6%	41%	1%	4%	1%	1%	9%	0.28	263
High (packaging) quality	21%	40%	17%	4%	2%	2%	3%	3%	10%	0.24	189
Attractive	36%	7%	6%	26%	1%	2%	1%	6%	15%	0.21	130
Tasty	32%	14%	3%	11%	7%	3%	2%	11%	15%	0.16	124
Cheap	24%	13%	15%	15%	6%	6%	4%	6%	13%	0.13	108
Luxurious	61%	7%	5%	4%	1%	1%	4%	3%	15%	0.38	107
Familiar	29%	20%	7%	16%	1%	12%	1%	5%	9%	0.17	92
Healthy	30%	0%	5%	30%	10%	2%	2%	7%	15%	0.20	60
Preservable	44%	26%	14%	2%	4%	0%	4%	2%	5%	0.29	57
Natural, authentic	42%	7%	2%	23%	12%	5%	2%	2%	5%	0.25	43
Concrete cue perceptions: Materials & structural features											985
Transparent	41%	41%	1%	1%	1%	2%	2%	6%	6%	0.33	264
Flexible	0%	39%	44%	0%	1%	1%	6%	1%	7%	0.35	142
Carton	2%	0%	14%	1%	53%	0%	1%	0%	29%	0.37	137
Pouch	0%	0%	87%	0%	7%	0%	0%	0%	6%	0.76	114
Canned	1%	7%	0%	0%	0%	0%	91%	0%	0%	0.84	81
Plastic	0%	1%	46%	0%	0%	29%	0%	19%	4%	0.33	72
Pot	0%	81%	0%	0%	0%	16%	3%	0%	0%	0.69	70
Glass	0%	88%	0%	0%	0%	0%	0%	0%	12%	0.78	58
Round	11%	70%	0%	0%	0%	0%	11%	4%	4%	0.52	27
Rectangular	5%	5%	15%	0%	55%	0%	0%	0%	20%	0.36	20
Concrete cue perceptions: Graphic features											186
Green graphic design	48%	1%	0%	45%	0%	0%	1%	0%	6%	0.43	107
Graphics, appearance	45%	2%	2%	23%	6%	2%	4%	2%	13%	0.26	47
Imagery	56%	0%	0%	38%	3%	0%	0%	0%	3%	0.46	32
Concrete cue perceptions: Product features											60
More contents per package	33%	15%	6%	3%	15%	3%	0%	6%	18%	0.18	33
Liquid soup	100%	0%	0%	0%	0%	0%	0%	0%	0%	1.00	16
Dry powder soup	0%	0%	0%	0%	100%	0%	0%	0%	0%	1.00	11
Remaining cue perceptions	29%	10%	17%	8%	13%	1%	1%	8%	13%	0.16	145

Note. Rows sum to 100%. *n* = number of elicited cue perception descriptions per category. *HI.* = Herfindahl index, equalling the sums of squared row proportions. C9-21 are aggregated and displayed in a single column due to their small size.

Table 2
Cluster contents and packaging proportion patterns.

Cluster	Concrete cue perceptions	Abstract cue perceptions	Liquid carton		Can		Plastic pouch		Mixed pouch		Glass jar		Dry carton sachet		Bioplastic pot	
			Conv.	*Sust.*	*Conv.*	*Sust.*	*Conv.*	*Sust.*	*Conv.*	*Sust.*	*Conv.*	*Sust.*	*Conv.*	*Sust.*	*Conv.*	*Sust.*
1	opaque, red, graphics, imagery, label	modern, familiar	0.86	0.52	0.87	0.54	0.9	0.54	0.54	0.34	0.57	0.29	0.71	0.42	0.5	0.27
2	transparent, pot, glass, round, rigid	quality	0.15	0.15	0.37	0.37	0.05	0.04	0.29	0.27	0.97	0.97	0.13	0.13	0.65	0.63
3	pouch, bag, carton, flexible	bad protection, bad quality	0.28	0.27	0.07	0.06	0.83	0.84	0.95	0.97	0	0.03	0.63	0.62	0.25	0.26
4	green and red, imagery, graphics	traditional	0.03	0.91	0.02	0.93	0.01	0.9	0.13	0.72	0.12	0.85	0.02	0.84	0.11	0.77
5	carton, rectangular, dry powder	(in)convenient, not sustainable	0.43	0.42	0	0.01	0.13	0.11	0.01	0.02	0.01	0.02	0.94	0.98	0.02	0.03
6	plastic, pot, bioplastic	sustainable	0.01	0.03	0.01	0.01	0.06	0.01	0.15	0.01	0.04	0.01	0.06	0.02	1	0.82
7	canned, opaque, round, rigid	inconvenient	0	0	0.92	0.81	0	0	0	0	0.02	0.01	0.01	0	0.04	0.04
8	transparent, plastic	unattractive	0.02	0	0.11	0.1	0	0.04	0.89	0.99	0.01	0.04	0.03	0.03	0.39	0.39

Note. Conv. = "conventional-looking"; *Sust.* = "sustainable-looking" graphic schemes.
Clusters 9–21 are not displayed due to their small sizes and are not readily interpretable.

different lay theories and heterogeneous perceptions and do not hold a singular, consistent idea of what sustainability means.

5.1.4. Consumer and life cycle analysis (LCA) comparison

Consumer judgments of packaging sustainability were compared with the outcomes of LCA (Table 3). Fig. 2 shows a graphical display of this comparison. The results show several important incongruences between consumer judgments and LCA. Glass jars, which were perceived as very sustainable by consumers (ranked 2nd of 7), were actually least sustainable according to LCA. The bioplastic pot also caused a comparatively large environmental burden in LCA (ranked 5th of 7), while consumers ranked it first in terms of sustainability. Plastic and mixed material pouches, as well as dry carton sachets, were considered as not sustainable by consumers but were amongst the most sustainable options according to LCA endpoints. The differences in sustainability assessments are smallest for cans (consumer ranked 7th, LCA ranked 6th) and liquid cartons (both ranked 3rd). On the whole, the results show that consumer perceptions are severely misaligned with LCA outcomes.

Table 3
Consumer sustainability perceptions and life-cycle analysis results.

Packaging type	Consumer perceptions		Life-cycle analysis	
	Sustainable packaging: ratings *(higher = more sustainable)*	Ranking[a]	ReCiPe end points: outcomes *(higher = less sustainable)*	Ranking[a]
Bioplastic pot	60.62	1	2.85E-05	5
Glass jar	57.55	2	4.72E-05	7
Liquid carton	54.27	3	1.10E-05	3
Plastic pouch	46.33	4	1.20E-05	4
Mixed pouch	45.76	5	8.40E-06	2
Dry carton sachet	45.14	6	1.90E-06	1
Can	43.22	7	3.17E-05	6

[a] Rankings: 1 = most sustainable, 7 = least sustainable.

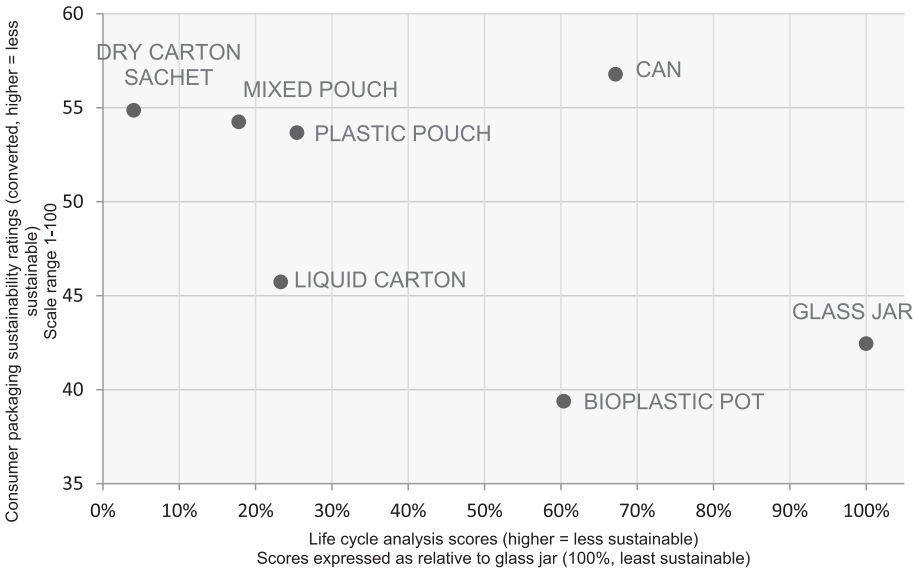

Fig. 2. Consumer & ReCiPe Endpoints LCA comparison.

5.2. Inferential benefit linkages

5.2.1. Inferences between consumer packaging-related perceptions and product benefits

To understand how packaging-derived cue perceptions are predictive of packaged product benefits (Phase 2), the 28 content categories identified with content analysis were used as predictors for benefits using multilevel regression (Level 1 = product benefits, Level 2 = respondents) using maximum likelihood (ML) estimation to take into account the hierarchical nature of the data. Proportions were calculated to indicate the extent to which a product belonged to any of the 28 content categories. To account for possible differences in respondents' overall tendencies to "check" more or less frequently in the CATA task, these proportions were mean-centred per content category and per packaged product. Whenever a respondent did not have any cue perceptions in a content category, zeros were assigned instead. Random intercepts and slopes were included to best model between-subject differences, because cue perceptions were formed in idiosyncratic terms. To compare the fits of multilevel models, a Level-1 pseudo-R^2 (ρ^2) was calculated (Hayes, 2006), which measures the proportion of variance explained by predictors that is not explained by between-respondent (Level 2) differences.

The results (Table 4) showed that all benefits that were obtained from prior research also showed up in respondents' spontaneous cue perceptions, and these cue perceptions were significantly related to their corresponding benefits (all p's < 0.001). For example, the cue perception of "cheap" was significant in relation to the benefit of inexpensive pricing ($b = 21.10$, $p < 0.001$). The presence of a sizeable group of cue perceptions related to sustainability ($n = 293$) and the highly significant effects on sustainable ($b = 17.25$, $p < 0.001$) and sustainably packaged ($b = 22.38$, $p < 0.001$) benefits indicate that sustainability is spontaneously associated with packaging and that these perceptions are predictive of sustainability benefits. Sustainability cue perceptions also contributed to naturalness ($b = 6.13$, $p < 0.001$) and healthiness ($b = 3.78$, $p < 0.001$) benefits and, to a lesser degree, to taste ($b = 1.63$, $p < 0.10$) and quality ($b = 2.32$, $p < 0.05$), whilst detracting from inexpensive price perceptions ($b = -4.02$, $p < 0.05$). Overall, these results showed that spontaneous inferences based on mere packaging design cues were predictive of all included packaged product benefits.

5.2.2. Effects of graphic scheme and packaging materials on product benefit evaluations

A series of repeated measures ANOVAs was conducted with packaging materials and graphics as independent variables and packaged product benefits (and attitudes) as the dependent variables. The results (Table 5) show that the main effects of both the manipulated material and graphic designs were significant for all benefits and attitudes. The largest effects were found for graphics on naturalness ($\eta_p^2 = 0.146$, $p < 0.001$) and for materials on

Table 4
Regressions of product benefits on elicited cue perceptions.

Cue perceptions	Benefits							
	Sustainable	Sustainably packaged	Convenience	Healthiness	Naturalness	Taste	Inexpensive	Quality
Intercept	50.98***	50.41***	72.39***	59.46***	55.84***	62.92***	56.56***	60.17***
Abstract cue perceptions								
Convenient	0.79	2.48†	12.86***	1.83*	2.19*	1.53†	−1.13	1.84†
Sustainable	17.25***	22.38***	1.38	3.78***	6.13***	1.63†	−4.02**	2.32*
Novel, modern	−1.18	−2.15*	0.59	−1.91*	−4.70***	1.66	−3.43*	1.91
High (packaging) quality	0.69	−2.1	2.39†	2.68**	1.64	3.98*	−3.68*	5.23***
Attractive	5.10**	2.65	0	6.64***	4.55**	8.82***	−5.30**	8.59***
Tasty	0.98	1.23	1.92	7.98***	6.22**	13.30***	−11.46***	12.15***
Cheap	−6.05*	−5.65**	0.06	−6.66***	−6.95***	−9.81***	21.10***	−11.31***
Luxurious	1.4	−0.69	−1.49	2.38*	2.77*	0.74	−7.65***	2.13†
Familiar	−0.97	1.06	4.19*	0.03	−0.04	4.94**	−1.84	4.44**
Healthy	5.07**	2.63	−1.59	10.21***	8.38**	6.07*	−4.93†	5.11*
Preservable	1.32	0.12	−0.94	−1.58	−1.13	−0.32	8.68***	−1.92
Natural, authentic	6.74**	5.02*	1.26	6.07**	11.19***	5.20*	−3.74	6.69**
Concrete cue perceptions: Materials & structural features								
Transparent	5.93***	7.67***	−0.59	2.50**	3.49**	1.21	−3.76***	2.53*
Flexible	0.15	−0.07	5.02**	0.88	−0.12	−0.31	1.48	−0.52
Carton	1.95†	3.75*	0.38	−1.35	−1.5	0.05	1.34	−0.25
Pouch	−2.24	−4.34**	−2.36	−0.18	−0.42	1.61	−1.65	1.3
Canned	−2.31	−4.73*	−0.51	0.24	1.98†	2.56*	1.74	1.66
Plastic	−1.13	−2.33	1.05	0.2	1.88†	1.9	−1.41	−0.3
Pot	4.99*	5	2.70†	0.44	3.02	1.37	−2.71†	1.95
Glass	1.75	5.19	−0.42	0.94	1.57	2.91*	−3.25	3.80**
Round	0.29	−1.04	−3.78†	1.42	−0.28	−0.9	1.02	−1.93
Rectangular	2.28	4.75	2.24	0.25	0.82	−1.94	−0.92	−1.45
Concrete cue perceptions: Graphic features								
Green graphic design	2.02	0.57	0.39	2.31†	4.14**	0.01	0.57	−0.06
Graphics, appearance	1.73	3.17	−1.45	−1.46	−1.01	−4.60*	−1.09	−3.39†
Imagery	1.12	2.23	0.86	4.18*	6.35*	1.62	−1.35	1.22
Concrete cue perceptions: Product features								
More contents per package	7.04**	6.07*	−2.23	4.83	5.72*	6.71*	1.17	6.83*
Liquid soup	6.24	3.56	−1.14	8.25	8.90*	4.14	0.79	9.78†
Dry powder soup	12.78†	13.6	−1.06	−22.31†	−23.09**	−16.45†	20.09***	−17.67†
ρ^2/*Overall model fit*	0.34***	0.36***	0.38***	0.34***	0.34***	0.35***	0.33***	0.39***

Note. *p*-values for the overall regression model were calculated by comparing −2 Log Likelihood of the null model versus the full model, using X^2 significance values ($df_{change} = 71$). Intra-class correlation coefficients were 0.49 for benefits. Likelihood-ratio test significant at $p < 0.001$ for all regression models compared to fixed slope models.
†$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

sustainable packaging (η_p^2 =0.134, $p < 0.001$). Notable medium-sized effects of packaging materials were found on (product) sustainability (η_p^2 =0.099), attitude (η_p^2 =0.097), taste (η_p^2 =0.010), naturalness (η_p^2 =0.094), healthiness (η_p^2 =0.094), quality (η_p^2 =0.087), and inexpensiveness (η_p^2 =0.071), with all *p*'s < 0.001. Graphic design had medium-sized effects on both sustainability measures. The remaining effects were small ($\eta_p^2 < 0.06$) and are not further discussed. Specifically with regard to the two graphic schemes, the pattern of results suggests that the sustainable-looking scheme was perceived primarily as more natural, and it was perceived as more sustainable and healthier than the conventional-looking schema. Looking at individual material means (averaged over graphic designs, scale 1–100), respondents indicated the bioplastic pot ($M = 60.6$) and glass jar ($M = 57.6$) as the most sustainable packaging. Cartons were rated as intermediately sustainable ($M = 54.7$) when a single packaging was used (i.e., liquid carton), but when multiple smaller packages were used (i.e., dry carton sachets), they were perceived as least sustainable ($M = 45.1$), together with plastic pouches ($M = 46.3$) and cans ($M = 43.2$); differences not significant. In terms of attitudes, tomato soups packaged in liquid cartons ($M = 64.5$), plastic pouches ($M = 63.9$), glass jars ($M = 65.4$) and bioplastics ($M = 62.6$) were evaluated best. Dry carton sachets ($M = 55.7$) and the mixed material (transparent) pouch ($M = 58.4$) were evaluated least positively.

5.3. Benefit evaluation and attitude formation

To analyse the effects of the benefits in determining consumer attitudes towards the tomato soup products, a random intercept multilevel regression model was used (Table 6). The results indicate that the benefits significantly predicted attitudes (*p's* < 0.001, except inexpensive pricing, where $p = 0.10$). Taste ($b = 0.34$, $p < 0.001$) and quality ($b = 0.21$, $p < 0.001$) were the most important in influencing product attitudes. It is notable that the most-salient packaging perceptions, that is, convenience ($b = 0.01$, $p < 0.001$) and sustainability ($b = 0.12$, $p < 0.001$ for packaging sustainability and $b = 0.05$, $p < 0.001$ for product sustainability), were not the most important in determining overall attitude. Naturalness ($b = 0.08$, $p < 0.001$) and healthiness ($b = 0.12$, $p < 0.001$) were also intermediately important. Inexpensive pricing ($b = 0.02$, $p = 0.010$) was deemed least important, but could likely play a larger role in actual purchase choices than in attitudes. Overall, these results support the final phase of the conceptual model, as all benefits contributed meaningfully to attitudes. The results also show that salience is not equal to importance; although packaging led to sustainability inferences, sustainability only modestly contributed to attitudes toward the tomato soups.

Table 5
Results of repeated measures ANOVAs.

Material type	Graphic scheme	Sustainably packaged	Sustainable	Convenience	Healthy	Naturalness	Taste	Inexpensive	Quality	Attitude
Means										
Liquid carton	*Conventional*	53.80 *b*	49.14 *b, c*	75.60 *a, b, c, d*	59.40 *a, b, c, d, e*	49.75 *b, c*	66.57 *d, e*	56.25 *c, d*	60.57 *b*	66.34 *c, d*
	Sustainable	54.74	53.68	72.18	61.74	58.42	62.28	59.02	59.36	62.73
Can	*Conventional*	42.79 *a*	44.25 *a, b*	71.32 *a, b, c*	58.04 *b, c, d*	57.57 *c, d, e*	66.35 *d, e*	61.33 *c, e, f*	61.80 *b*	63.08 *b, c*
	Sustainable	43.65	48.41	70.06	61.05	57.20	62.77	60.53	59.64	60.78
Plastic pouch	*Conventional*	44.62 *a*	47.86 *a, b, c*	75.62 *c, d*	61.32 *c, d, e*	55.67 *c, d, e*	68.80 *e, f*	52.53 *a, b, c*	65.47 *c*	64.80 *b, c, d*
	Sustainable	48.03	50.36	73.57	62.45	58.62	64.85	55.03	61.85	62.99
Mixed pouch	*Conventional*	45.65 *a*	46.57 *a, b*	70.12 *a, b*	58.69 *b, c, d*	54.11 *b, c, d*	60.62 *a, b, c*	56.20 *a, b, c, d, e*	58.48 *b*	58.13 *a*
	Sustainable	45.86	47.65	70.44	59.20	57.19	60.68	57.14	57.85	58.72
Glass jar	*Conventional*	56.76 *b, c*	56.39 *d*	72.96 *a, b, c, d*	61.89 *c, d, e*	58.13 *d, e*	67.04 *d, e, f*	50.72 *a, b*	65.73 *c*	65.74 *c, d*
	Sustainable	58.34	57.57	72.76	64.04	61.10	66.20	53.37	63.86	65.00
Dry carton sachet	*Conventional*	44.27 *a*	46.62 *a, b*	70.99 *a, b, c*	52.08 *a*	45.82 *a*	58.26 *a, c*	61.49 *e, f*	54.35 *a*	56.10 *a*
	Sustainable	46.01	47.74	69.94	53.16	51.61	55.35	62.82	54.22	55.28
Bioplastic pot	*Conventional*	59.68 *c*	57.68 *d*	73.69 *b, c, d*	59.10 *a, b, c, d, e*	56.51 *c, d, e*	60.14 *b, c*	52.71 *a, b, c*	59.13 *b*	62.10 *b, c, d*
	Sustainable	61.55	59.80	74.17	60.28	60.00	61.03	52.73	60.11	63.11
Partial eta-squared										
Main Material		0.134^{***}	0.107^{***}	0.018^{***}	0.094^{***}	0.094^{***}	0.103^{***}	0.071^{***}	0.087^{***}	0.097^{***}
Main Graphics		0.065^{***}	0.099^{***}	0.041^{**}	0.043^{**}	0.146^{***}	0.047^{**}	$0.012^{\dagger}$	$0.015^{\dagger}$	0.016^{*}
Material * Graphics		n.s.	0.015^{**}	0.018^{**}	n.s.	0.047^{***}	0.030^{***}	0.009^{*}	0.015^{**}	0.030^{***}

Note. a–f = post hoc results of differences in means between materials in alphabetic order (means ascending), based on Sidak post hoc correction for multiple comparisons. Analysed based on the means of both graphic designs. Results with the same notation do not significantly differ from each other.
$^{\dagger}p < 0.10$.
$^{*}p < 0.05$.
$^{**}p < 0.01$.
$^{***}p < 0.001$.

6. General discussion

6.1. Theoretical implications

The present study aims to increase understanding of consumers' perceptions of packaging and the role of sustainability therein. First, the study investigates perceptions and associations that are salient amongst consumers in relation to packaging materials and graphics. The research demonstrates that packaging can readily give rise to thoughts about sustainability. This is in line with previous research, where consumers are found to relate packaging chiefly to considerations of both convenience and sustainability (Van Dam and Van Trijp, 1994; Lindh et al., 2016a). Yet, there is a low consensus among consumers about how sustainable different packaging designs are. Two reasons can underlie this heterogeneity. Consumers differ as to which aspects of sustainability they recognize, for example, whether they consider recyclability, reusability or the apparent excessiveness of the packaging material used. Additionally, consumers may differ in their perceptions of how the packaging designs perform on these aspects of sustainability. The current results also suggest that impressions of novelty, quality, and attractiveness are salient on an abstract level.

Second, the study adds to the understanding of consumers' benefit inferences based on packaging. The abstract cue perceptions evoked by differences in packaging are very consistently linked to determinants of food product choice defined in prior research (Steptoe et al., 1995). Thus, impressions based on the packaging tend to "spill-over" to the packaged product as a whole. The results also support the notion that sustainability perceptions are closely related to other benefits such as naturalness and healthiness (Binninger, 2015; Magnier et al., 2016; Van Rompay et al., 2016), better taste (Becker et al., 2011), higher costs (Luchs et al., 2012) and an overall increased quality (Magnier et al., 2016). Material choice has a strong effect on perceived sustainability, but consumers are also affected (and could be misled) by graphical influences.

Third, this paper contributes to the scarce literature that compares consumers' sustainability judgments and more-accurate assessments of sustainability of expert (LCA) models (Tobler et al., 2011; Van Dam, 1996). The results show that consumers judge plastics and metals to be least sustainable, while they judge glass and bioplastics as most sustainable, followed by (single) cartons. These results are very similar to prior findings (using non-student samples) by Lindh et al. (2016a,b) in Sweden, Van Dam (1996) in The Netherlands and Allegra et al. (2012) in Italy. Comparing the consumer scores to the outcomes of the life-cycle analyses of these seven packages reveals that the most-sustainable packaging options according to LCA (dry carton sachets and mixed material pouch) are deemed least sustainable by consumers. Similarly, the most-sustainable packages in consumer perceptions (bioplastic and glass) are ranked fifth (out of seven) and last in LCA. Consumer intuitions are thus very inaccurate, and in some cases are practically opposite to life-cycle assessments. Therefore, these findings stress the opposition between consumer beliefs and 'objective' environmental impacts as a threat to sustainable development.

Finally, the findings provide insight into how product attitudes are formed through packaging. The measured benefits are generally determinants of consumers' attitudes towards the tomato soup products. However, the most-salient packaging-based inferences about convenience and sustainability are only intermediately important in determining attitudes and are subordinate to inferences about quality and taste. This suggests that in their attitude formation, consumers stick closer to generally important benefits, even though these benefits are more distant from the actual distinguishable features they directly perceive.

6.2. Managerial implications

One of the key challenges for packaging managers, marketers and designers is to develop sustainable packaging designs that are acceptable to consumers. While developing packaging designs, it should be taken into account that different materials communicate different levels of sustainability to consumers, which may not be in line with LCA outcomes. Therefore, even though consumers generally hold positive attitudes toward sustainable packaging, it should not at all be assumed that consumers will readily make the right environmental choice. This presents a challenge in terms of persuading consumers to choose packaging alternatives that, based on their own knowledge, they would normally not believe to be environmentally friendly. At the same time, graphic aspects of packaging design also implicitly communicate sustainability, and these may often be more deliberately designed to signal sustainability (e.g., by the use of green and sustainable-looking graphics). This could mislead consumers (e.g., as in "greenwashing"), but it could also be used to promote packaging types that consumers would not intuitively perceive as sustainable.

Moreover, the study suggests that deliberate design changes aimed at reducing the environmental burden of packaging are likely to lead to implications for other perceived benefits. These design alterations could also signal unintended and undesirable trade-off consequences. For example, changing a product's packaging from a metal can to glass is likely to increase perceived sustainability, but such packaging will also be prone to lead to higher price perceptions. To increase marketplace success, more-sustainable packaging should be positioned to complement (rather than detract from) important product purchase benefits such as taste and quality.

6.3. Limitations and future research

Several limitations of the current study and avenues for future research can be distinguished. First, the study uses a student sample. Although there are no large differences in packaging sustainability judgments between student samples and research using more-representative samples, caution is still advised in terms of generalizing toward populations.

Second, in real purchase scenarios, consumers may be less likely to (extensively) compare different packaging options of the same product compared to a lab setting. Soup products in the study carried the same brand name, and hence, attitudinal differences could only reflect consumer inferences based on packaging materials and graphics. Brand attitudes were not measured. Although there is no a priori reason to expect that brand attitudes influence the inferences consumers draw from packaging design, the roles of brand image and packaging could be investigated in future research. Moreover, it is worthwhile to venture beyond attitudinal measures toward more-realistic purchase scenarios in future research, as this would improve the external validity of the outcomes.

Third, some limitations of the study design should be noted. The stimuli consisted of images of common packaging options. For this reason, the bioplastic and dry carton sachet packaging had to be labelled to indicate their properties, as these were otherwise not discernible. Consumers may also perceive the dry soup in the carton sachet as different from the liquid soups, although the results showed this basis for distinction to be uncommon as few respondents mentioned this in the elicitation of cue perceptions. The sachet's LCA outcomes were favourable in part due to its low volume compared to liquid soup packaging. It should be noted that contexts and/or specific methodologies can affect the relative LCA performances of the packaging types, and this is inherent to the LCA methodology. It should also be noted that the study's design did not randomize stimuli presentation after the elicitation phase, hence possible order effects (in relation to ANOVAs) could not be excluded.

Fourth, this study did not focus on how the retail environment could affect the role of packaging sustainability in consumer perceptions. Because purchases are increasingly made online, often affecting the role of packaging (e.g., due to the presence of additional secondary packaging or a different interaction with the product's packaging), future research could look into whether the role of packaging and its environmental concerns vary due to such contextual factors.

Finally, while the current research quantifies the gap between consumer judgments and LCA's environmental impact assessments, future research could expand upon this by designing and testing interventions to reduce this gap. It may, for example, be fruitful to investigate whether consumers' confidence in using packaging cues affects their ability to change their beliefs.

7. Conclusions

This study aims to advance the understanding of consumer response toward packaging sustainability by advancing and empirically testing perceptual, inferential and attitudinal aspects of consumer decision making that arise from packaging material and graphical differences. New insights show that (packaging) sustainability is salient but not highly important for determining attitudes. It is shown that packaging has consistently powerful effects on product-level expectations and, by extent, sustainable packaging is most likely to be accepted when it enhances perceptions of product quality and taste. The current study also contributes by showing that consumers' sustainability perceptions of packaging are highly diversified, possibly because they perceive different aspects of sustainability (e.g., recyclability vs. reusability) and vary in how they believe packaging performs on such aspects. It is shown

Table 6
Regression results of attitude on benefits.

Benefit	*b*	SE	*df*	t	p	95% Confidence Interval	
						Lower Bound	Upper Bound
(Intercept)	−0.66	1.13	2414.398	−0.59	0.558	−2.88	1.56
Sustainably packaged	0.12	0.010	3364.868	12.56	<0.001	0.10	0.14
Sustainable	0.05	0.012	3391.373	4.43	<0.001	0.03	0.08
Convenience	0.01	0.009	3458.773	10.9	<0.001	0.08	0.11
Healthiness	0.12	0.014	3485.897	8.27	<0.001	0.09	0.15
Naturalness	0.08	0.012	3471.646	6.58	<0.001	0.06	0.10
Taste	0.34	0.014	3454.565	23.97	<0.001	0.31	0.37
Inexpensive	0.02	0.008	3372.097	2.57	0.010	0.01	0.04
Quality	0.21	0.015	3485.114	14.13	<0.001	0.18	0.23

Note. Intraclass correlation coefficient = 0.30. Level-1 pseudo R-squared (ρ^2) = 0.66.

that these consumer perceptions do not align with life-cycle assessment; rather, consumers rely on their own lay beliefs and can be easily misled by salient cues that may not be very relevant for objective environmental impacts.

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Appendix. Stimuli

"Conventional-looking" graphic scheme

Plastic pouch

Liquid carton

Glass jar

Mixed material pouch

Can

Bioplastic pot

Dry carton sachet

"Sustainable-looking" graphic scheme

Plastic pouch

Liquid carton

Glass jar

Mixed material pouch

Can

Bioplastic pot

Dry carton sachet

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jclepro.2017.06.036.

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