Current Research in Environmental Sustainability 7 (2024) 100259

Contents lists available at ScienceDirect

Current Research in Environmental Sustainability

journal homepage: www.sciencedirect.com/journal/current-research-in-environmental-sustainability

Consumer meaning -making of packaging functions for sustainable food packaging – Insights from qualitative research in Finland

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ARTICLE INFO

Keywords:
Food packaging
Consumers
Sustainability
Packaging functions
Qualitative research

ABSTRACT

The growing amount of waste originating from food packaging has increased both practical and scholarly interest in the technological development, design and marketing of sustainable food packaging. This article, in turn, scrutinizes the sustainability of packaging from the consumer perspective, arguing that the sustainability of a package is entangled not only in the content of the packaging but also in the functions it fulfills, and that the conditions for acceptable sustainable food packaging from the consumers' perspective differ from the packaging industry's views. We examine the meanings of the packaging functions for consumers based on the data collected through an online consumer panel in Finland. The findings show that while the containment function of packaging plays the most important role for the consumer in general, the informative function is particularly relevant from the viewpoint of sustainability. Moreover, we identified two novel functions consumers highly appreciate –usability and disposability – that are largely irrelevant from the industry perspective. The findings provide important insights in the transformation to more sustainable food packaging and in the development of novel packaging solutions.

1. Introduction

The transformation of the food system in the past sixty years has entailed the increased consumption of packaged foods leading to negative environmental impacts (Langley et al., 2021). Thus, environmental sustainability of food packaging has in recent years received a lot of both scholarly and political attention (e.g., European Commission, 2018; Plastics Europe, 2015). On top of the packaging waste that constitutes over one half of total global waste, the production of packaging consumes natural resources and produces carbon emissions (European Commission, 2018; Marsh and Bugusu, 2007). Worldwide, the carbon emissions induced by the packaging sector are valued to be around 5% (Krauter et al., 2022). However, the estimated share of the carbon emissions of the food package in relation to food products may vary significantly depending on the product group (from two to 40%) (Krauter et al., 2022). The carbon emissions of the food packaging are highly dependable on the packaging material used, single-use versus reuse, and of the end-of-life possibilities, if the packaging material is recyclable or not, for instance (Ingarao et al., 2017; Krauter et al., 2022; Otto et al., 2021). In particular, mismanaged plastic waste originating from food packaging, such as single-use plastics, is heatedly discussed.

From the viewpoint of environmental sustainability, packaging is still essential because it prevents food waste (Verghese et al., 2015), which has large environmental impacts (FAO, 2013; Williams and Wikström, 2011). Consumers' role in the generating global food waste is major: according to recent estimates, over 60% of it originates from the household level (Brennan et al., 2021). Packaging enables safe transport and protects the content against contamination, loss and damage (Sacharow and Griffin, 1980). Further, packaging helps in food preparation and in storing fresh, frozen, processed, and takeout foods and usually contains information about the product that can be essential from a sustainability perspective. Food packaging significantly contributes to food safety by protecting and preserving the food. Therefore, the packaging of food is also a sustainability solution, not only a problem.

Research on sustainable packaging is mainly focused on technological development, design, and marketing. Yet, how consumers both individually and as a group view packaging is of crucial importance when it comes to the facilitation of sustainable packaging, particularly to the commercialization of novel packaging solutions. New innovations

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https://doi.org/10.1016/j.crsust.2024.100259
Received 8 March 2024; Received in revised form 10 June 2024; Accepted 10 June 2024
Available online 17 June 2024

need the acceptance of the consumers, who often have conflicting needs and perceptions regarding convenience, hygiene and security, costs, and the perceived environmental impact. It can be argued that the next generation of sustainable solutions indeed requires deep understanding of consumer dynamics related to sustainable packaging (Boz et al., 2020).

Sustainable packaging has been defined in a myriad of ways, but most often concentrating on four principles: sustainable packaging is effective, efficient, cyclic, and safe (Sonneveld et al., 2005; WPO, 2008). These definitions mostly focus on the packaging as a product itself, rather than acknowledging the content of the packaging nor the services it renders. The content and the service of the packaging are, however, essential from the consumers' point of view and thus we argue that sustainability of packaging must be assessed as an entity with the content and service (Tynkkynen et al., 2025) throughout the value chain, ensuring that the package fulfills its functions.

In literature regarding packaging, the most important functions for packaging have been defined as follows: Containment function, the protective function, preservative function, transportation function, informative function, and selling function (Jeantet et al., 2016; Robertson, 2009, 2013; Soroka, 2002). Yet, looked from the consumer perspective, the main functions that consumers associate with packaging may differ from the basic functions as seen from the packaging technology perspective. Consumers can, for example, appreciate usability, easy disposal or even coloring which are not considered important features if looked purely from a technical point of view.

In our research conducted in Finland, Northern Europe, a virtual consumer panel was used to gain knowledge of the consumer perspectives to sustainable food packaging. One of the panel's aims was to find out consumer preferences regarding the functions and features of food packaging and to understand what are the conditions (sustainable) packaging has to meet in order for the consumers to consider them acceptable for their everyday lives – This was studied through analyzing the meanings that consumers gave to food packaging (qualitative content analysis). Thus, this inquiry informs us about features of food packaging that consumers have difficulties with compromising, regardless of environmental impacts of the packaging. These difficulties mostly stem from the fact that food package consumption is a systemic issue, implying that it is an indispensable part of daily food routines and dependent on the system of provision (e.g., Müller and Süßbauer, 2022). This information as well as the consumer perspective at large is relevant for encouraging a transition towards a more sustainable food packaging culture, which here refers to a systemic change where the consumers, but also all stakeholders involved are moving towards and executing more sustainable practices. We see the sustainable food packaging culture – from the consumer point of view – as a system where the consumer is able to rely on producers' ability to choose to most sustainable packaging for the particular product, where the consumer has optimal possibilities to dispose the food packaging in an environmentally friendly manner, and where the infrastructure for providing the above mentioned opportunities is well-planned and executed in the most equal and accessible way.

In this paper we examine the meanings given to food packaging by consumers in terms of the main functions of the package. By meanings we do not (only) refer to culturally shared norms (Sahakian et al., 2021), but rather scrutinize them in close connection with different practices related to food packaging purchase and consumption. Thus, in this article we apply the definition of consumption derived from the theories of practice, where consumption is, as sociologist Alan Warde (2005) put it, not considered a practice in itself, but rather a "moment in almost every practice". In this sense, the food packaging itself is not the object of consumption but part of the mundane and often inconspicuous consumption related to food. Warde (2005) definition of consumption includes appropriation and appreciation of goods consumed, but in case of food packaging, it is necessary to add the dimensions of "the end of life" of goods. We therefore see the inclusion of such concepts as devaluation, divestments and especially disposal, as formulated by Evans (2019), to be important addition to our definition.

The ultimate objective of the analysis is to identify factors enabling and preventing sustainable packaging choices made by consumers, – in other words what are the conditions for consumer to accept sustainable packaging solutions – hence potentially offering the food packaging industry an insight into how to implement more sustainable packaging. We take the functions defined by the packaging industry as a starting point, but extend the analysis beyond those to scrutinize further meanings, and the prioritization of the functions by the consumers.

2. Analytical framework

In previous research, consumers and sustainable packaging have mostly been addressed from the perspective of attitude models (Rokka and Uusitalo, 2008). Abundant research teaches us about consumer choices, purchase decisions and cue utilization (Hallez et al., 2023; Resciniti, 2020) and how these can be oriented towards more sustainable consumption e.g., by improving product characteristics (Bangsa and Schlegelmilch, 2020; Trudel, 2019). Sustainable product characteristics are considered to support the best possible balance between economic prosperity, environmental friendliness and social justice and equity, while at the same time meeting the requirements set by regulations, policies, infrastructure, and markets (Maxwell and van der Vorst, 2003). Even if some scholars contest this notion by questioning the sovereignty and agency of the consumer and their ability to make informed sustainable choices (Akenji, 2014; Hobson, 2002; Nordin and Selke, 2010; Princen et al., 2002), consumers' role is no doubt important. It has been shown that the awareness related to sustainability issues influences consumers' behavior and can lead to more sustainable consumption choices (Resciniti, 2020), although it needs to be noted that consumer perceptions and interpretations of sustainable food packaging very often differ from the results of scientific life cycle assessments, as noted by Otto et al. (2021). Consumers judge packaging material by criteria of circular economy, natural looking material, and design. By the consumers, the environmental impact of paper/cardboard and metal are rated in similar matter as scientific measure, whereas – in terms of sustainability - plastic packaging is underestimated and glass and biodegradable plastic packaging are highly overestimated (Otto et al., 2021). More to the point, 'green packaging' can represent a response to consumer request to make more conscious choices (Nguyen et al., 2020). According to Herbes et al. (2020), how consumers perceive environmental sustainability of packaging is mainly related to the packaging material and structure. Thus, the design or the material of the package can provide the consumer with various psychological and functional motivations (Gurtu and Arendt, 2020). Similarly, a sustainability label on the package can influence consumers' purchase decisions but is more likely to do so if the label simultaneously somehow communicates of personal gain (Cho, 2015). While low cost would probably be the most obvious personal gain, the gain could also be something that resonates with the values of the consumer or communicates about the quality or safety of the contents, for example.

What role packages play for the consumer can also be reflected with the help of studies that scrutinize what happens when the product is provided without a package. This applies to so-called zero-waste solutions, such as selling products directly to customers' own containers. A study by Beitzen-Heineke et al. (2017) shows that when using their own containers, consumers' appreciation of food grew and as they could choose their own portions, less food waste was created. The further positive aspect of a zero-waste business model is that it offers consumers a choice not to be distracted by the package or worry about its disposal (Beitzen-Heineke et al., 2017).

This article contributes to the research on consumers and sustainable food packaging from a novel perspective, focusing on the meanings of packaging for consumers and on the functions of packaging that the consumers value most. We lean on the idea that food packaging is

inseparable from food consumption, forming 'an integral material element of food consumption' (Müller and Süßbauer, 2022). Therefore, we studied the meanings of packaging functions given by the consumers by focusing on the practices related to food package purchase and consumption (see section on the data and methods; also Spaargaren, 2011).

Packaging has many functions which have varying weight depending on the stakeholder. From the producer's point of view, the primary function of packaging is to contain the product, enabling the convenient and safe delivery. In case of food packaging, protective and preservative functions are of great importance to ensure the safety of the contents and valued particularly by the retailer as well as the consumer. Informative function is important not only for consumers, but also in terms of logistics and retail. The selling function is provided by the package as a platform for brand logos and other information on the package (Kuswandi, 2016). These functions can be regarded as crucial for maintaining the current system of provision and thus effectively battling against food waste, for instance.

As noted, packaging functions have previously been defined and scrutinized mainly from the viewpoint of packaging technology (Jeantet et al., 2016; Robertson, 2009, 2013; Soroka, 2002). Robertson (2013, 2009) makes a distinction between four functions of packaging: containment, protection, convenience, and communication. In Jeantet et al. (2016), the functions are divided into three broader categories that are 1) technical functions of packaging (containment, logistics, protection, utility of use), 2) communicative functions of packaging (marketing, information, communication) and 3) the environmental function of packaging (eco-design, disposal by avoiding landfilling).

For this paper, an analytical framework was extrapolated from the abovementioned packaging technology literature. Six functions of a food package were discerned: containment, protection, preservation, transportation, informative and selling functions. These were then supplemented inductively from the empirical data with several other functions (see sections 3 (methods) and 4 (results)).

The containment function is a self-evident function of a food package. Without containment function the product (i.e., food) in most cases cannot be distributed, thus the product and package are integral parts of each other and highly dependent on the composition and physical properties – such as liquid vs. solid substances – of the product itself (Jeantet et al., 2016; Robertson, 2013).

The protective and preservative functions are among the core functions of a food package and closely interlinked. The package protects the product against mechanical stress and impacts caused by external environment, but also against various pests such as insects and rodents (Jeantet et al., 2016) or tampering. The protective function can also mean barrier properties, such as impermeability or permeability of air, water, or various gases, to prevent any undesired changes, such as mold or deterioration, in the food (Jeantet et al., 2016). Additionally, protective function ensures that for instance aromas are preserved inside or outside the package (Robertson, 2013). The package ensures the protection of the food, which in turn enables the preservation of the food (Robertson, 2013). In the worst case, the product is no longer preserved if the integrity of the package is violated.

The transportation (sometimes also labelled as logistics) function of the food package ensures the cost-efficient and effortless transfer and storage throughout the whole value chain from producer to the consumer (Jeantet et al., 2016).

The informative function is divided into two parts: the mandatory information, such as list of ingredients, nutritional values, allergens, best before date, and the like, and the useful information, such as labelling of organic food or symbols related to the recycling or type of the packaging materials (Jeantet et al., 2016). Moreover, the informative function enables tracking of faulty goods in possible recall cases.

The selling function includes both communications and marketing actions. It is tightly related to the product brand, its visibility and recognizability through for instance colors, shape and materials used in the package (Robertson, 2013). Package enables consumer targeting: various packages are seen by millions of consumers daily; thus, a package is a medium to influence consumer's purchase decision (Jeantet et al., 2016).

3. Material and methods

3.1. Data collection

The data for this paper consists of two sets of data. The main data was collected through a consumer panel, but also data collected by a survey was used to a limited extent. The survey that aimed at finding out the impacts of a COVID-19 pandemic on consumers' behavior regarding food packages in Finland was conducted with the software Qualtrix in June–November 2020. For the survey, 342 responses were received. Some of the 19 multiple choice questions and the nine open-ended subquestions of the survey touched upon the functions of a package and thus supported the analysis for this paper.

Consumer behavior or consumer preferences have been studied within myriad frameworks, such as cue utilization theory (e.g., Orquin et al., 2020; Steenis et al., 2017), consumer perceptions on sustainability (e.g., Dilkes-Hoffman et al., 2019; Herbes et al., 2018; Zeng and Durif, 2019) or consumers' willingness to pay (e.g., Hao et al., 2019; Martinho et al., 2015). Many studies regarding consumer green behavior have indicated, that there is a significant gap between the values and actions of consumers (e.g., Kollmuss and Agyeman, 2002; Rokka and Uusitalo, 2008), which proposes a risk of misleading results in surveys or other more quantitative oriented methods – people are sometimes prone to answer based on their values or attitudes instead of actual behavior. Qualitative research, such as ethnographic methods, offers some tools to overcome such pitfalls, as the questions are open-ended and answers tend to be more in-depth. Participant observation also creates an opportunity for researchers to observe such contradictions themselves. Covid-19 pandemic caused major challenges for conducting more traditional ethnographic fieldwork, which led us to conduct research in an online platform. Creating an online consumer panel also enabled us to reach a geographically wider pool of participants. The consumer panel aimed at gaining comprehensive knowledge of consumer perceptions and consuming habits regarding food packaging in order to e.g., examine the potential prospective ways to engage consumers with new novel packaging solution, but also in to better understand food packaging's role in food systems among consumers in general. The panel platform was executed and designed by Kernwert, a digital qualitative research software provider, and the content for the panel was planned and executed by our research team. The consumer panel was active from December 2021 to August 2022. The panel was formed by an open invitation circulated via different channels: social media, e-mailing lists, and through a project website. We were mainly interested of reaching those consumers who are already environmentally aware consumers, i.e., key players, paying attention to food packaging properties and disposal procedures, and potentially ushering novel food packaging solutions and their acceptance for wider use. 54 panelists were recruited. These participants will be later referred by their ID number given by the panel platform (e.g., ID22), to secure their anonymity. The majority of the participants were highly educated (91%, $n = 49$). They were mostly living in urban areas (69%, $n = 37$) and the size of the household was 1–2 persons (57%, $n = 31$). We did not conduct analysis based on the participants' genders, and thus excluded this information. Participants were, however, able to inform us of their respective gender, voluntarily. Two of the panelists did not want to tell their demographic details. Four panelists were later (spring 2022) interviewed to gain a deeper understanding of the topics that emerged from the panel assignments to be most relevant; the context of situation while shopping groceries, living arrangements, recycling and sorting circumstances. These participants are here referred to as 'Interview (date of the interview)'. During this research the researchers followed the guidelines of

Finnish National Board of Research Integrity and accordingly, this research was not required under the law to go through the ethical evaluation process as is does not include vulnerable participants and no sensitive topics were involved. The participants were properly informed and their consent was acquired appropriately. Their anonymity has been secured in every stage of the research.

Despite many benefits, our research design did come with some challenges. First, as we did not invite specific participants, but instead spread an open invitation, we could not ensure the heterogeneity of our panel in terms of e.g., education level or place of residence. Second, as our goal was to engage participants for multiple months in order to learn their everyday lives and food packaging consumption habits in-depth, the participation was time consuming and it was challenging to motivate the participants after many weeks. There was a clear decline in activity of the participants as we moved onwards with our panel activities. However, this decline was anticipated and we designed our weekly tasks in such way that the most crucial tasks were introduced at the early stages of the panel work. Third, this methodology enabled us to study participants who are already environmentally aware and/or interested in food packaging as their motivation to participate stems from their personal interests or values. The challenge would be to recruit such number of participants if we were to study consumer habits, perceptions and attitudes of those consumers who are less inclined to be interested in environmental issues or food packaging in general.

The panel had weekly assignments which were planned based on our research questions but also formulated in interaction with the panelists. These research questions were both predetermined and formed due to the course of the answers we got from the panelists. For example, once it was clear that for the panelists, the most important barrier for effective sorting and recycling is the lack of proper instructions in packaging, we planned our next weekly assignment to measure the extent the panelists are familiar with the most common logos in regards to recycling instructions. In order to study which packaging attributes are most valued among our panelists, we assigned various tasks for them, e.g., asking them to photograph their packaging choices and explain why they chose the particular packaging, or asking them to describe situations when they found packaging poor, disappointing or un-practical. According to the given answers, we were able to generate prospective weekly tasks which would further explain issues raised during previous weeks. The co-creating interaction occurred via e.g., questionaries, feedback sessions and the chat section of our platform. The interaction helped us to understand consumer practices, needs and what issues consumers find to be most relevant (see Fig. 1. for more detailed description of panel tasks). In this sense, the panel formed not only an informative platform, but a co-creational dataset which quite successfully replaced the semi-thematic ethnographic interviews the pandemic precluded.

The assignments varied in type and extent; they included photo journals, shopping diaries or open answer questions related to shopping habits, packaging preferences, situatedness, power and responsibility regarding sustainable packaging systems, and recycling and sorting. Some assignments were more quantitative and formed of closed ended survey like questions. Some assignments were more visual – the panelists were asked, e.g., to design their own ideal packaging. The panel work also included online workshops with a packaging designer, where

Fig. 1. An overview of the topics dealt with in the consumer panel.

we – together with some panelists, discussed the best possible food packaging design from the point of view of the consumer.

3.2. The method of analysis

To make sense of the meanings that the consumers give to packaging in terms of the important functions, qualitative content analysis and abductive thematic analysis were applied. Content analysis is a method often applied in social sciences to analyze written of spoken data and recognize, for example, social structures and social interactions (e.g., Elo and Kyngäs, 2008; Weber, 1990). Thematic content analysis refers to the analysis method defined by Braun and Clarke (2012) as a method that can help the researcher to identify reoccurring themes and systemically organize them across the whole set of data. According to Braun and Clarke (2012), thematic content analysis is "a way of identifying what is common to the way a topic is talked or written about and of making sense of those commonalities". Furthermore, abductive thematic analysis means that thematic categories were formed through the interplay between existing theory – i.e., packaging functions identified in previous literature – and data, noticing also new, unexpected findings.

The replies of the panelists were downloaded from the panel software and processed further in Excel, i.e., the demographic details of respondents, and in Word, i.e., the data was restructured by identifying the respondents as single Word documents (in total 54 with a variable number of replies to the given panel tasks). Responses show that some of the participants were very active in their panel work, whereas some replied only to a few tasks.

The data in Excel and Word documents were imported in nVivo software, which is a tool for qualitative data analysis, for further processing. The panel data was in Finnish language and the data also included pictures and videos, provided by both the project and the respondents themselves; also, these, as well as the transcribed interviews were imported into nVivo. As the first step of the analysis, the available demographic details by each respondent were combined. Then a list of preliminary codes was formed based on the analytical framework (deductive coding) (Skjott Linneberg and Korsgaard, 2019). The list of codes evolved during the coding process, and additional codes were added (inductive coding) (Cohen et al., 2018; Skjott Linneberg and Korsgaard, 2019). There were three coding rounds altogether: 1st round was conducted by one researcher/author (Researcher 1) and the 2nd round by another researcher/author (Researcher 2), thus completing the codes of the 1st round. Third round was again done by Researcher 1 to remove double codes and complete codes, if still needed. Codes were translated into English when designing the visuals, such as figures.

4. Results

4.1. Containment function

From the consumer point of view, the function of containment is somewhat invisible, as for the vast majority of consumers, the container is not what matters, but the content. However, this function becomes obvious when the package is exceptionally good, or even more so, exceptionally bad. Our consumer panelists recognized the importance of this function especially in connection to design, material and over-packaging, as did our participants in their panel entry "*As I'm ridiculously bad and lazy at cooking, I often buy semi-fabricated products and convenience food. Delightfully often they come in packaging that is easy to recycle as plastic or cardboard (which I do) and have not been overpacked."* (ID41).

Less material can also create other advantages for the product. As our interviewee pointed out, minced meat packaging has been developed to contain less material, but it also contributes to practicality by being more compact.

> *I noticed (—-) with minced meat, that they were packed in a big plastic containers with a lot of air. Now the packages have gotten smaller, so I'd prefer those- since they are packed in a more compact way, which I appreciate. That's one example that I've noticed.* (Interview 2.5.)

From the data it can be concluded that for our panelists the containment function was indeed essential, yet not often conscious function – but it was considered important that the packaging contained in the simplest possible form, and avoidance of unnecessary "over-containment" was seen preferable (cf. Ruippo et al., 2023).

4.2. Protective function

For the panelists, the protective function of the packaging was most concrete in terms of protecting the product once it is bought, delivered, and stored at home. The worst type of food packaging was considered to be one that breaks easily, thus failing to protect the product. This was particularly important when carrying the groceries home. The experience of a package breaking while delivering the product could potentially negatively affect the decision to buy the product again in future.

> *Although the package is plastic and thus not my favorite, I choose it particularly for its practicality. I go to the grocery store by foot and the quark containers with aluminum lid are inconvenient as I sometimes fear they'd break before I get home with my shopping bags, and therefore would end up as food waste.* (Consumer panel ID41).

Similar types of protective functions were needed with selected vegetables and fruits (e.g., tomatoes) when packaging them only in a plastic bag would risk them getting squeezed and softened while delivering them home. This is a common example where food packaging becomes visible and can have an impact on consuming habits, like demonstrated by the experience ID33 mentioned in their consumer panel entry: *"Poor packaging has been highlighted during corona epidemic with home deliveries. Some groceries have been so badly and tightly packaged that sensitive fruits and tomatoes have been damaged on their way home."*

Protective function was also important in terms of safety and hygiene. This was especially visible when panelists were thinking about products with zero packaging or biodegradable materials. The hygiene perspective has been one of the main concerns with zero-packaging (also in literature, e.g., Beitzen-Heineke et al., 2017; Wiefek et al., 2021; De Temmerman et al., 2023). It is worth noting that the panelists participated the panel activities amidst the COVID-19 pandemic, and thus the hygiene perspective of food packaging was probably overemphasized in comparison to any other period of time. During the first months of the pandemic (Spring and Summer 2020), consumers avoided buying unpacked groceries, such as fruit or freshly baked pastries and bread (see Tynkkynen et al., 2021).

4.3. Preservative function

From the consumer perspective, food packaging is functional if it enhances food security and integrity, but also prevents food waste. In this respect, one of the most preferable attributes for a food package is a possibility to reclose and reopen the package in a practical manner. This attribute was considered important in preventing food waste and consequently, saving money.

On occasion, the product was viewed better with packaging in comparison to zero-packaging. Most often mentioned example of this was cucumber. It had been observed by some of the panelists that without the plastic wrap, cucumbers' lifespan was significantly decreased and therefore consumers were inclined to buy them with plastic on, despite generally avoiding plastic wrapping with fresh vegetables and fruit: *"(—) I'm familiar with my consumption habits and it is not worth buying a cucumber without the plastic wrap, as it would end up in bio-waste in no time."*(ID22).

Regarding food preservation, re-closing abilities of certain packages were seen important. For example, cold cut packaging was seen as poorly designed if one could not re-close it properly. The package would

eventually cause the product to be ruined after opening the packaging, which was seen problematic, as mentioned in Interview 4.4.:

> *Cold cuts for example, the packaging should be re-closable, so that the product would last even for few days. As a matter of fact, it'd be rather nice to have re-closable packages for the frankfurters also – majority of them does not have it.*

4.4. Transportation function

For the consumer, one of the most important aspects of logistics is the product's delivery from the store to home. Some packages are assessed to break easily in the shopping bags, which is often a cue for not to buy it. What is, however, most relevant is the means of transport which the consumer is using – the biggest and heaviest products do not get purchased if one is doing shopping on foot, bicycle, or public transport. As ID32 describes when doing shopping on foot: "*You must assess how much you can carry, although the walk is not far. You cannot buy large packages like super-sized bags of toilet paper*". In an interview (Interview 21.4.) participant also notes that *"I buy canned tomatoes quite often, usually every time I go food shopping. If I'm on foot, I might prefer the one with carboard packaging* [instead of a can, note by author]*, since it is lighter and more convenient to carry home."*

In terms of packaging size, rather important factors were how the product can be placed at home – is there enough room in the refrigerator or in a kitchen cabin, for example. This factor became more relevant with limited space at home. From the logistical point of view, it was also an important transportation function for the consumer, that the packaging is easy to sort at home and then transport to the recycling points or facilities.

> *The aspect of sorting becomes apparent in a way that I avoid glass jars and tin cans, because they take up a lot of room when they are empty. If there is an option for a package that can be folded, I prefer that.* (ID17)

The emphasis and nature of this function varied between the respondents, mainly between those who live in an apartment building where the recycling facilities are provided by the building association, or in their own house outside the city, where the purchase and placement of the sorting bins are the responsibility of the homeowner and the waste must be self-delivered to recycling bins, which can be far away. However, it is noteworthy that the emphasis of this function varies significantly whether it is examined through a definition by the industry or the consumer. For the industry, the logistical chain ends when the product reaches the consumers' home (or other destination), whereas for the consumer, the logistical and storage-related issues are still relevant long after.

4.5. Informative function

The informative function of packaging for the consumer resembles that of the industry, although it can be seen as opposite; whereas for the industry, packaging offers a place to print information or stamp labels - i.e., *give* information, for the consumer packaging offers the means of *getting* the information. This particular function offers some explanations as to why non-packaging (or zero packaging) is problematic – providing information is essential for the industry (due to legislation also), and in many cases, it is also necessary for the consumer. Zero packaging solutions would open new problems regarding responsibility and liability, for example.

Panelists were environmentally aware consumers, and for them, the cues for environmentally friendly packaging were to some extent factor in choosing the particular packaging. For the panelists, the most important cue for "green packaging" was that it can be easily sorted and recycled. Therefore, the packaging information regarding recycling and sorting instructions were highlighted, and often mentioned important, like the response of ID22 illustrate: *"Clear instructions for sorting are necessary, and it is good if they are on a package visibly and largely enough, preferably in written form."* ID45 concurs by stating that *"For me, quality means recyclability. So, if this attribute is clearly indicated on a package, it really enhances the image of the product significantly."*

In addition to sorting (and recycling) instructions, packaging information was seen important in terms of communicating the origin of the products. For Finns, it is often important to buy domestically produced food. Even so much, that the product can be left unpurchased if the certificate indicating its origins is not apparent, as demonstrated by ID34's reply: *"It is essential that there is a logo which indicates Finnish origins, otherwise I don't take notice of it while doing my 'quick scan'* [of potential purchases; note by authors]*"*.

Similarly, if the consumer has dietary restriction, the absence of proper ingredient list is often a deal breaker.

> *I generally purchase the same products over and over again – and I've gone through their ingredient lists (––). Right behind the ingredients, the second most important criterion is that the product is Finnish (or at least Nordic) while making the decision to buy.* (ID51)

4.6. Selling function

The Selling function of packaging gets different dimensions when considered from the consumer perspective. This function often offers the consumers cues for environmental friendliness (or other attributes they consider important), and thus may be a guiding factor in making the purchasing decision. With this function, the multisensory experience of packaging became more significant, and the aesthetics, brands and colors were mentioned as important- for our panelist (cf. Sekki et al., 2023), as these sometimes indicated environmental friendliness. What also became evident, is the importance of the sense of "the feel of the packaging". This was especially relevant in one of the weekly assignments, when the panelists were asked to participate in a packaging design process and were consulted on assessing the environmental friendliness of a packaging. We could not provide them with the physical packaging yet, so they had to rely on the visuals only, which was problematic for many. It was evident the panelists needed to know "the feel of packaging", whether it was e.g., sturdy or shimmering: *"Neither of the packages feel higher quality than ordinarily, but then again, the sense of quality is also affected by the sense of touch which cannot be assessed here."* (ID45).

For the most part, however, the selling function for the consumers meant that the packaging enabled them to recognize the already familiar products and certificates that were most important to them. The most often mentioned certificates or logos were those indicating domestic products, healthy products, and organic products.

> *When I purchase tea* [for example; note by authors]*, the material of the packaging does not play any role. But the appearance of the package is important. There are so many options to choose from, that an alluring appearance (like colors, shapes, and title) guide my choices very much.* (ID52)

4.7. Consumer functions

On top of the functions of packaging that also packaging industry recognizes, we identified two novel functions important for the consumer panelists. We call these novel functions *consumer functions* and elaborate on their definition and meaning in the following.

4.7.1. Usability

Since the previously determined packaging functions mainly highlight the functions and attributes that support the products journey from the factory to the consumer's home, the usability of the packaging from the end-user's perspective has not been getting much attention in term of packaging functions (albeit much attention has been given in e.g.,

marketing research). However, it was evident in our data, that for the consumers, the usability of the packaging was one of the most important attributes. Although consumers mention they rarely base their purchase decision on the package, packaging with very poor usability could mean that the product it contained would be left unpurchased again.

> *When I'm doing grocery shopping, I buy products, not packages. So only if the package proves to be totally useless, then it has an impact on whether I buy the product again. But if it works* [the package; note by author]*, even so and so – but the product is something that I really like, I'd buy it, regardless of the package.* (Interview 4.4.2022).

In terms of functions, this means that packaging does not only contain but it also delivers the product to the consumer. So very poor packaging would somehow restrain the proper delivery or use of the product. Many also mentioned bad packaging to be hard to open and/or dose:

> *Bad food package is hard to open – like a traditional milk carton, which nearly ever opens on the first try. I never buy a milk carton without the plastic cap because they* [the traditional milk carton which in this context means a milk carton with a carton spout; note by author] *ruin the whole user experience.* (ID21).

> *The most annoying packages are those that do not open easily: a plastic film which tears when opening the package although it would be meant to re-close, or those milk cartons which have too strong glue on the spout. Those oat milk cartons that make it hard to pour the milk: the liquid comes either too slowly or spills wherever.* (ID34).

The importance of re-closability was mentioned various times, as did ID41: *"In general, a very bad food package could be one that a) breaks easily, b) is hard to re-close between the times you use it, and c) is possibly hard to recycle."* This attribute was also highly connected to preventing food waste, which was often brought up while contemplating the good/bad packaging attributes. Food packaging which does not re-close properly, does not preserve the food effectively and thus promotes food waste.

The usability function was somewhat overlapping with other functions, such as preservative function. Preserving the product at home, even after the packaging was opened, was an important function for the consumers. The insurance for good preservation qualities of packaging was mentioned important due to the need to prevent food waste – both for economic and environmental reasons.

In addition to opening and (re)closing the packaging, general practicality was often perceived as important. These practicalities consisted e.g., the need for space in the refrigerator or kitchen cabinets, the selections of various packaging sizes, the dosing abilities of the packaging (easy to pour, scoop, and empty the container entirely, for example).The possibility to empty the container entirely was also connected to sorting and recycling properly, as it is important to recycle packaging that are relatively clean, and cleaning the packaging was seen as irritating.

One major factor in finding the packaging practical was how easily it can be disposed. The most important, and often the only meaning for the packaging (unless re-used) for the consumer is to contain the product. Once the packaging has fulfilled this meaning, it needs to be easily disposed. This need was so obvious in our data that it was defined as the other consumer function, *disposability*.

4.7.2. Disposability

There are, of course, many ways to dispose food packaging once it no longer serves its purpose, but our consumer panelists were environmentally aware consumers and proper sorting and recycling was important and natural for them. Therefore, this function could have been more highlighted than it would in consumer research in general, although in the future the pressure for recycling and sorting at home will most likely increase and made compulsory for many, at least in EU.

The panelists had differing ways of living, which affect the way they sort and recycle – e.g., living in the city center in an apartment where the recycling bins are provided by the building association creates different possibilities for recycling than for those living in a scarcely populated areas were recycling points are dozens of kilometers away. Similarly, sorting at home is usually easier for those living in a house with more space for different sorting bins than living in a smaller apartment. Nevertheless, each panelist considered sorting and recycling of food packaging to be very necessary. Thus, the easiness of sorting and recycling is of importance for our panelists. This disposability function consists of many packaging attributes, the most important of which being the clear instructions for sorting at home. The panelists preferred packaging that was made of as few types of materials as possible, as summarized by one of our panelists ID20 and ID15:*"Recyclability and material efficiency for me are important attributes for a package, and they do have an impact on my purchasing decisions."* (ID20).

> [A good] *"package is functional and easily recyclable. There are clear instructions how it should be recycled and info on the package material. (—)* [whereas bad packaging is; note by author] *a package which mixes material so that they cannot be separated and thus recycled."* (ID15)

In addition to material, the size, durability, and for example ability to fold into compatible size when sorting, were mentioned as factors that could support and advocate for better sorting and recycling, thus supporting disposability functions of the packaging. Biodegradability was also brought up, but it was obvious that there are still many questions associated with biodegradability of packaging. Consumers do not necessarily know what it means, and in which conditions the packaging is biodegradable. Often the qualities of biodegradable packaging were seen poorer than the "regular ones" in terms of food preservation, for example. However, if the biodegradable could mean that the packaging would be compostable in-home conditions, for example in the compost in the garden, it would be welcomed as an easy option and would serve the disposability function very well.

> *I'm sure there will be a lot of new innovations in terms of material. Like very light packages, and shaped so that they are sensible for logistics and transport. And of course recyclable, and it would be nice to see more biodegradable packages, compostable packages.* (Interview 21.4.2022).

4.8. Summary of the functions

As noted, we have identified two novel functions for packaging, coined from the analysis of consumer meaning making. In addition, we have found that although many industry-defined packaging functions apply to consumers also, there some significant differences on emphasis and experience-based perceptions regarding how these functions demonstrate in everyday life practices. As indicated earlier, the same codes could apply to several functions defined by industry; thus, part of the codes, e.g., preservation and re-closability, were categorized under several functions. As depicted in Fig. 2, the function that was given most weight was the containment function, and the disposability function superseded. Selling, usability, transportation, and preservative functions followed. The selling function could be somewhat overemphasized in the study as part of the panel questions were directly related to a specific topic, that is, the perception of the environmental friendliness highlighting the selling function.

From the packaging industry's viewpoint, the definition of containment function focuses more on the design and material of a food package, whereas consumers appreciated the simplest possible form avoiding "over-containment". Regarding the informative function of packaging, the panelists highlighted package labeling and markings, and in the case of the preservative function, functionality and preservation features. For consumers the disposability function, in turn, refers to recycling and sorting while the usability function underlines the importance of such features as preservation, re-closability, opening, and easiness to use.

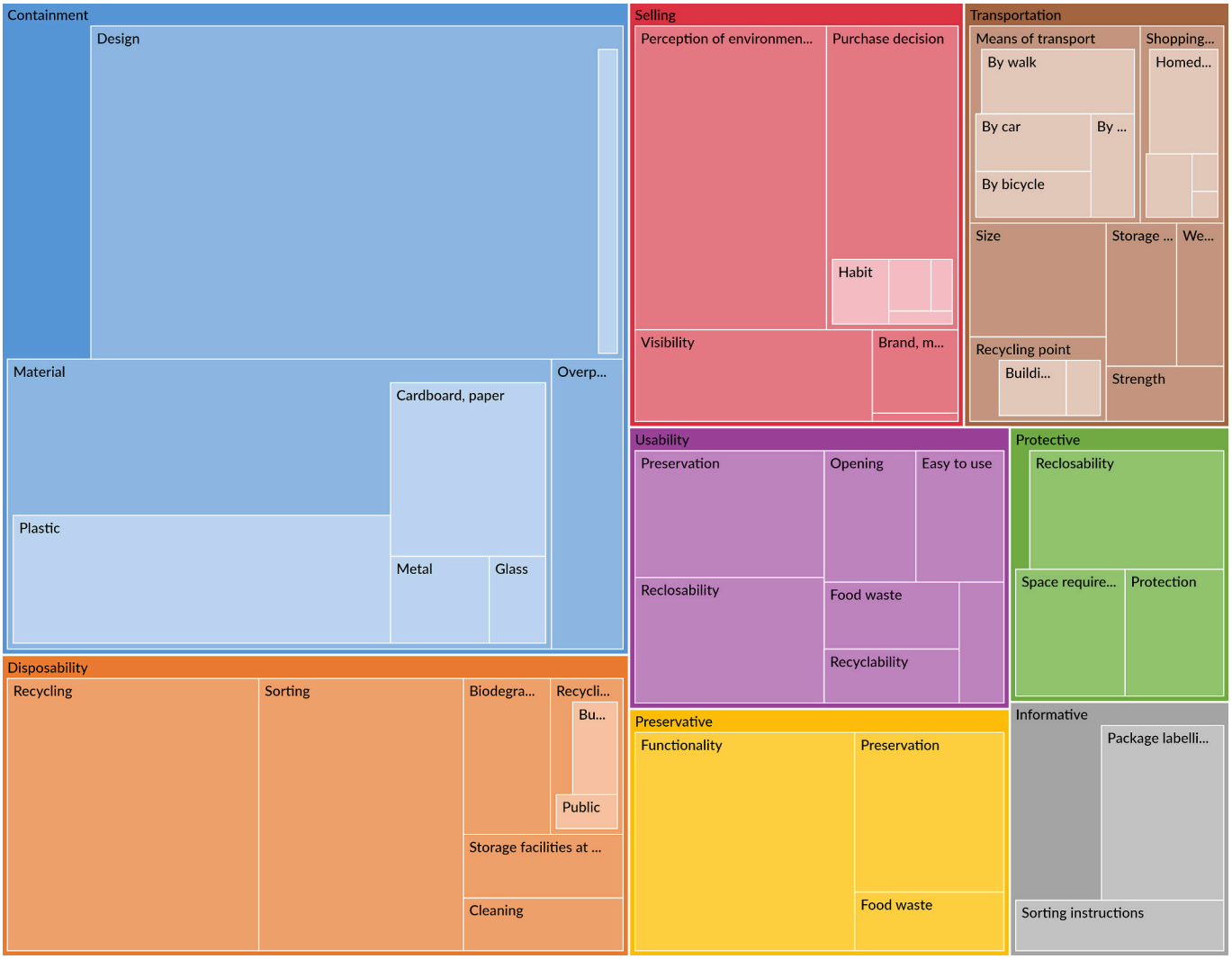

Fig. 2. Functions and codes, as identified from consumer panel data, compared by number of coding references. Each function is demonstrated in their respective colors and each code within them is represented in size according to their scale of frequency.

There were similarities and differences in function definitions among the consumers. These are depicted in Table 1. (below) where we compare the packaging industry's definitions to the meanings given to the functions by our consumer panel. The comparison indicates, for example, that the transportation function was interpreted differently depending on the perspective. The traditional transportation function is concerned of the chain from producers to end-users, whereas consumer perspective of functions highlights the importance of getting the product home and storing it easily – including transportation also after the product is used and the package becomes waste. There is a noteworthy difference when it comes to the information function, too: despite quite similar definitions, consumers emphasize the role of packaging for getting information regarding sorting and recycling.

5. Discussion and conclusion

Our analysis reveals that while the packaging functions defined by the packaging industry are obviously relevant also from the consumer point of view, consumers highly appreciate some packaging attributes and functions that are largely irrelevant from the industry perspective (beyond what is required by law and regulation). These functions were identified as usability and disposability. Moreover, the analysis shows that consumers give differing meanings to different packaging functions depending on the case and situation. Which packaging function plays the most important role can thus be very situational. For example, transportation function can be decisive in situations when the way of delivery so requires. In general, consumers seem to appreciate the simplest possible package that fulfills its functions in the situation at hand. The role of the packaging in making the purchase choice is highlighted when the package is exceptionally good – or bad.

How could the findings of our analysis help in the transition towards to more sustainable food packaging culture? What kind of barriers and drivers do they form for sustainable packaging choices made by consumers and what are the implications for food packaging industry in the transition towards more sustainable packaging. What are the conditions the food packaging must meet in order for consumers to accept them and thus usher way for novel solutions for more sustainable packaging?

First, the findings highlight the information function of packaging in the guidance towards more sustainable packaging choices. Previous research has similarly identified that consumers need guidance in recognizing sustainable packaging (Otto et al., 2021) and that consumers lack knowledge when it comes to new packaging, bio-based materials in particular (Ketelsen et al., 2020). It is often only based on the information given on the package that the consumer can learn about the characteristics of the packaging and how it should be recycled. Labels and information printed on the package have been recognized as playing a major role in guiding consumers choices, yet the package itself rarely evokes consumers attention in terms of purchase choices

Table 1
Industry definitions of packaging functions in comparison to the meanings identified in the consumer panel data.

Function	Industry definition	Meanings for the consumers (drawn from consumer panel data)
Containment	Enables the distribution of the product, thus the product and package are integral parts of each other and highly dependent on the composition and physical properties – such as liquid vs. solid substances – of the product itself.	Consumers see this function to mean packaging and/or the physical properties of the packaging. Important were also the design, simplicity, material (incl. carboard, glass, metal, plastic), and overpackaging
Protection	One of the core functions of a food package. Protection against mechanical stress and impacts caused by external environment, but also against pests or tampering. Protection also means barrier properties, such as impermeability or permeability of air, water, or various gases. Additionally, protective function ensures that for instance aromas are preserved inside or outside the package.	For consumers this was important in terms of food waste prevention, product protection, and preservation. *Re*-closability was often mentioned as a good way to secure the above mentioned. Functionality is essential.
Preservative	Overlapping with protective functions as the package ensures the protection of the food, which in turn enables the preservation of the food (Robertson, 2013, 3). In the worst case, the product is no longer preserved if the integrity of the package is violated.	From the consumer perspective also, this function was overlapping with protective function and preservation, food waste prevention and functionality were mentioned often.
Transportation	Ensures the cost-efficient and effortless transfer and storage throughout the whole value chain from producer to the consumer.	From the consumers' point of view, this function is relative to the means of transportation they use for shopping (e.g., bicycle, car, public transport). Transportation is also considered in terms of storage spaces, or the strength, durability, size, and weight (of the packaging), and the frequency of visiting grocery store, home delivery / take – away. Notably important was the transportation from use to disposal: the location of recycling points (incl. public or building owned).
Informative	The mandatory information (e.g., list of ingredients, nutritional values, allergens, best before date) and the useful information (e.g., organic food labels or symbols related to the recycling and sorting). Informative function also enables packaging tracking.	Package labeling and information are important, but notably sorting/recycling instructions were mentioned very often.
Selling	Communications and marketing actions, product brand; e.g., colors, shape, and material. Package enables consumer targeting: thus, a package is a medium to influence consumer's purchase decision.	For the consumers, this function was mentioned in terms of marketing, purchasing decisions, and perception of environmental friendliness. It was also mentioned that the "feel or sense" of the package might be important, as well as visibility, habit, brand, and distinctiveness.
Usability	No definition	Usability or practicality came up from several points of views: Preservance, Closability, Prevention of Food waste, Easy to open and Easiness (in general), and disability of the packaging. Packaging needs to be easy to sort and recycle.
Disposability	No definition	Disposability, from the consumers' perspective is related to Sorting, Recycling, Cleaning, Storage (space to store after sorting, before recycling), Biodegradability, and the locations of recycling points.

(Kuswandi, 2016). This was also evident in our analysis.

Second, for an environmentally aware consumer, not only the information on how the package can be sorted and recycled but also how this actually can be done, is important. Here, the disposability of the package can potentially be an important attribute contributing to a purchase choice of an environmentally aware consumer. Based on our findings, avoiding packaging waste is crucial for the aware consumers and they really consider the disposability of the packaging when they conduct purchase choices. Yet, as the study by Ruippo et al. (2023) who introduce a cyclical relationship of the sustainable food consumption shows, the average consumer does not pay much attention to the materiality of packaging until the package is emptied. Only when the package turns into waste, the consumer becomes aware of the packaging materials.

Interestingly, and supporting the findings of an earlier study from Australia (Brennan et al., 2023), consumers in our data seem to perceive packaging waste as a more serious environmental issue than food waste (even if this is by no means so, see Silvenius et al., 2014). Thus, packaging designed to simultaneously reduce food waste and the environmental impact of the packaging, not solely focusing on the former, is potentially most successful (cf. Coussy et al., 2013; Wikström et al., 2019).

Third, the situatedness of the meanings that consumers give to different packaging functions, and the connections of these meanings to overall food purchase and consumption practices offers a powerful reminder that consumers should not be treated homogenously regarding their choices or perceptions of packaging (see also Brennan et al., 2023; Ruippo et al., 2023). Packaging is not only relevant when making the purchase choice, but is also a constitutive element in transporting, storing, cooking, eating, and disposing practices (Müller and Süßbauer, 2022; Sekki et al., 2023). These elements affect the purchase choice, too. This implies that in different situations, the weight of the attributes that have an impact on the purchasing choice varies, as the choice depends on the abovementioned constitutive elements. Even if the consumer might appreciate the sustainability aspect, it does not necessarily every time correlate with the purchasing choice. Besides attributes of the packaging that might have more weight in a particular situation, consumers may also be forced to other trade-offs, such as those on product quality, performance, and price (Boz et al., 2020; Ketelsen et al., 2020). Of course, the purchasing choice may in some situations be made based purely on sustainability, omitting other meanings, functions, and other parameters. It was also worth noting, that our panelists found sensory experiences being important in determining e.g. the environmental friendliness or the quality of the product. These observation might become highly relevant when consumer are choosing the groceries online, being delivered to home. Not being able to assess new packaging solutions via one's own senses might have an effect on purchasing product with novel packaging.

Finally, the situatedness implies that food packaging suppliers and

companies should not be directed solely by consumers opinions of sustainability or the package attributes they consider most important. Instead, they should focus on employing scientifically proven sustainable packaging that meets consumer needs, and clearly communicate the sustainability to consumers (cf. Boz et al., 2020; Otto et al., 2021). As the food packaging is so tightly tied in practices of food consumption, these sectors should be better aligned to meet the needs of sustainable consumption, taking also note of the consumers' uneasy, cyclical relationship with the usage of packaging.

Funding

This work was supported by the Package Heroes – Project funded by the Strategic Research Council of the Academy of Finland under Grants 320215 and 346599.

Disclosure statement

The authors report there are no competing interests to declare.

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.

Data availability

The data that has been used is confidential.

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