Beyond the wrapper: Uncovering the effect of explicit and implicit packaging design cues on consumer perception and sustainable disposal behaviour

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Abstract

In pursuit of a more sustainable future, more and more firms are seeking alternative sustainable packaging and corresponding packaging communication strategies to signal its eco-friendliness and stimulate ecological consumer behaviour. Despite the majority of research focusing on the pre-purchase stage of the packaging life cycle, limited attention has been given to enhancing post-consumption packaging disposal. This study examines the effect of both implicit (design strategy: imitation vs. differentiation), and explicit (packaging visualization and claims: long vs. short supply chain) packaging design cues on sustainability perception and disposal behaviour. Results from a laboratory study demonstrate that packaging following a differentiation strategy (vs. imitation) has a positive effect on both perceived sustainability and disposal behaviour. Furthermore, the length of the supply chain, manipulated through on-packaging visualization and claims, significantly influences disposal behaviour, with a significantly higher proportion of consumers correctly disposing of the packaging when the supply chain is depicted as short (vs. long). The findings contribute to environmental psychology and packaging design literature, providing valuable insights to designers, marketers, and policymakers in formulating effective and sustainable packaging design interventions.

keywords: packaging design, implicit cues, explicit cues, connectedness to the origin of the supply chain, sustainability communication, sustainability perception, disposal behaviour

1. Introduction

The packaging sector is currently being challenged by plastic pollution, packaging-related waste, deteriorating air, soil, and water quality, climate change, and other contemporary concerns (Kumar et al., 2021). Single-use packaging, in particular, has been identified as a major contributor to plastic waste and its harmful effects on the environment (Herbes et al., 2018). Approximately 300 million tons of plastic waste is generated globally each year, with up to 50% of this waste coming from single-use plastic packaging (UNEP, 2018). This waste not only takes up space in landfills, but also enters the oceans and harms marine life. Plastic packaging that ends up in the oceans can break down into smaller pieces known as microplastics, which can be ingested by marine animals and end up in the food chain, including the food we eat (Jambeck et al., 2015). Furthermore, single-use packaging can also contribute to greenhouse gas emissions (Pasqualino et al., 2011), with estimates suggesting that packaging accounts for around 3% of the total carbon footprint of the European Union's economy (European Commission, 2013).

The environmental concerns around single-use packaging are driving the development and adoption of alternative eco-friendly packaging materials to replace the petroleum-derived materials on market, such as compostable materials (Crabbé Jacobs, Van Hoof, Bergmans, & Van Acker, 2013). In adopting these ecological materials in packaging design, a substantial amount of literature has focused on the impact of packaging design on the initial acquisition phase of consumption, with limited attention given to its role in shaping post-consumption disposal behavior (Trudel et al., 2016; Boz et al., 2020). However, achieving optimal sustainability in the packaging value chain requires an emphasis not only on steering the product selection but also on facilitating the collection and sorting for recycling, composting, reuse, and waste-to-energy processing, and other proper disposal and the processing of sorted packaging (Boz et al., 2020). Proper disposal of packaging is crucial for promoting sustainability throughout the product life cycle and ensuring its actual environmental efficacy. This is especially critical for eco-packaging like compostable packaging which is gaining popularity for its ecological advantages, if not disposed of adequately, it can contaminate the recycling stream, leading to adverse environmental consequences. Therefore, this research aims to extend the focus of sustainable packaging design from the product acquisition phase to end-of-life disposal by exploring effective packaging design strategies.

Packaging design consists of a range of different design elements like color, size, shape, images, logos, and claims. These design elements can be classified into two categories: implicit and explicit cues (e.g., Granato et al., 2022; Ischen et al., 2022; van Ooijen et al., 2017; Ketelsen et al., 2020). Implicit packaging cues refer to subtle, indirect and often non-verbal signals embedded within the packaging design that convey information or evoke certain associations. These cues can be communicated through visual elements, such as colors and overall appearance , as well as tactile and auditory elements (Granato et al., 2022). Implicit cues operate at a subconscious level and can influence consumer perceptions and behaviors without explicit awareness (Bocken et al., 2011; Dijksterhuis et al., 2005; Karjalainen, 2007; van Ooijen et al., 2017).

When employing these implicit cues in eco-packaging design, companies confront two distinctive design strategies: imitation or differentiation, each with its inherent advantages and risks (Granato et al., 2022; Krah et al., 2019; Magnier & Schoormans, 2017; Magnier & Schoormans, 2015). On the one hand, by following the imitation strategy, companies strive to replicate the characteristics of conventional packaging, such as the transparency of common plastic materials, while downplaying or concealing the typical features of eco-friendly materials. However, this imitation strategy poses the risk that consumers may not recognize the sustainability improvements (Heidbreder et al., 2019; Magnier & Schoormans, 2015). On the other hand, when adopting the differentiation strategy, the unique sensory properties inherent in eco-friendly materials are highlighted and leveraged as distinguishing factors. These distinctive attributes serve as reminders of novelty and distinctiveness, setting the eco-friendly packaging apart from conventional alternatives (Azzi et al., 2012; Rettie & Brewer, 2000; Schoormans & Robben, 1997; Underwood, Klein & Burke, 2001). This approach may also have potential

disadvantages, as it can hinder consumer acceptance and adoption of the packaging due to negative associations with eco-friendly materials (Magnier et al., 2015). The need for further research into determining which strategy is more effective in motivating positive consumer responses has been emphasized by several studies (e.g., Polyportis et al., 2022; Karana et al., 2018; Magnier et al., 2019). Recent research has found that the differentiation design strategy could increase the perceived sustainability of the packaging (Granato et al., 2022; Magnier & Schoormans, 2017; Magnier et al., 2016) and purchase intention (Magnier & Schoormans, 2015; Krah et al., 2019b). However, there is scarce research on how these approaches affect actual disposal behavior (e.g., Granato et al., 2022). Thus, in order to address this research gap, the first aim of this research is to investigate the effect of packaging design strategies (imitation vs. differentiation) on sustainability perception and disposal behavior.

Explicit cues typically complement implicit cues in a holistic ecological packaging design, effectively conveying sustainability messages to consumers (Magnier, Schoormans & Mugge, 2016; Magnier & Crié, 2015). Explicit packaging cues are direct and overt signals or messages communicated through explicit verbal or graphical information displayed on the packaging. These verbal cues often take the form of environmental claims, certifications, or statements that explicitly provide information about the product's sustainability attributes or responsible disposal instructions (e.g., Granato et al., 2022; Magnier & Schoormans, 2015; Magnier & Schoormans, 2017). Additionally, visual components such as eco-labels, logos, photography, images, and illustrations may be employed to attract attention (Piqueras-Fiszman et al., 2013) and reinforce the verbal messages (Magnier & Crié, 2015). These explicit cues can help consumers realize packaging sustainability when it is not directly recognisable for consumers, as seen in the context of adopting an imitation strategy (Rettie & Brewer, 2000; Magnier & Crié, 2015; Magnier & Schoormans, 2015). By providing additional insights into the intrinsic ecological attributes of the packaging, these explicit cues can facilitate consumers' comprehension of packaging sustainability (Herbes et al., 2020). Prior studies have demonstrated that explicit cues can positively influence consumer sustainability perception of the packaging (e.g., Granato et al., 2022; Magnier & Schoormans, 2015; Magnier & Crié, 2015), affective attitude (Magnier & Schoormans, 2015), and sustainable behavior such as purchase intention (e.g., Rossi & Rivetti, 2020; Magnier & Schoormans, 2015) and sustainable packaging disposal (Borgman, 2018).

Explicit packaging cues that provide the correct information is pivotal for consumer understanding of sustainability. This is especially relevant for today's consumers, who, particularly in western countries, feel increasingly alienated and disconnected from the natural world (e.g., Zhang & Jian, 2022; Ives et al., 2018; Melson, 2001). This subjective feeling of connection or distance to nature, is a key element of nature connectedness (Mayer and Frantz, 2004), a psychological construct that reflects how people think about, feel about, and relate to nature. The close relationship with nature can lead to an expanded sense of self and greater valuing of non-human species, and so to sustainable behaviour (Mayer & Frantz, 2004; Schultz et al., 2004; Roszak, 1995). A substantial body of research has underscored nature connectedness as a significant predictor of pro-environmental behaviour (Barragan-Jason et al., 2021; Dong et al., 2020; Martin et al., 2020; Mackay & Schmitt, 2019; Geng et al. 2015; Mayer & Frantz, 2004). To make this concept more relevant and applicable to packaging design, this study narrows the broad idea of "nature" to focus specifically on the connection to the origin of the supply chain. The psychological distance or connectedness between the consumer and the origin of the supply chain (i.e., raw packaging materials) is a dimension that remains largely unexplored. In particular, it remains unclear how this psychological distance or connectedness between the consumer and the origin of the supply chain can be manipulated, triggered and evoked through explicit packaging cues such as text, instructions and visualizations. By incorporating explicit cues that depict a short supply chain (vs. long), it could be possible to evoke a sense of closeness and connection to the source of the packaging, ultimately fostering a positive impact on sustainability perception and promoting proper disposal behaviour of the packaging. Therefore, the second aim of the current research is to investigate the potential impact of explicit cues, such as visualization and claims, on manipulating consumers' sense of connection to the origin of the supply chain and its influence on sustainability perception and disposal behaviour.

Implicit and explicit cues are fundamental components of a holistic packaging design, working in conjunction to effectively communicate meaningful messages to consumers (van Ooijen et al., 2017). While the importance of these cues is widely acknowledged, only a limited number of studies have delved into the intricate interplay and combined effect of both cues on sustainable consumer responses (Granato et al., 2022; Krah et al., 2019; Magnier & Schoormans, 2015). To bridge this knowledge gap and uncover the optimal conditions for driving

environmentally responsible behaviour, it is essential to explore how these cues interact with each other. Consequently, the third aim of this research is to investigate the relationship between implicit and explicit packaging design cues and their collective influence on sustainability perception and disposal behaviour. Therefore, the core research question is formulated as follows: *"How do explicit and implicit packaging design cues, as well as their interaction, affect consumer sustainability perception and disposal behaviour of the packaging?"*

The current study makes a significant contribution in several key domains. Firstly, at a theoretical level, the research enriches the existing body of literature on sustainable packaging design by extending the focus from green purchasing to sustainable disposal behaviour, providing a more holistic perspective. Secondly, it builds upon prior studies by examining the impact of implicit cues on driving sustainable disposal behaviour. Next, this study goes beyond the scope of previous research that mainly assessed the effectiveness of explicit cues, such as eco-labels and claims, in signalling packaging sustainability and guiding pro-environmental behaviour. Instead, it introduces a novel approach by combining packaging claims and visualizations that highlight the length of the supply chain. This innovative eco-packaging communication method paves the way for the development of effective packaging design interventions that steer consumers towards proper disposal behaviour. At a practical and managerial level, this research offers actionable insights for designers, marketers, and companies seeking to create sustainable packaging designs that effectively signal eco-friendliness to consumers. Additionally, policy-makers can leverage the results of our study to develop guidelines for adopting packaging design strategies and on-packaging visual and verbal communication to shape consumer perception and encourage more sustainable disposal practices.

The structure of the paper will begin with a review of the relevant literature, followed by an outline of the research methodology, analysis of the data, discussion of the results, and finally, the conclusion with implications, limitations, and suggestions for future research.

2. Theoretical background and hypotheses

2.1. Implicit packaging cues for consumer sustainable responses: imitation vs differentiation strategy

Implicit packaging cues, such as visual (e.g. colors, overall look), tactile, or auditory packaging elements, play an integral part of the sustainable packaging design (Granato et al., 2022). These cues tend to be processed automatically and unconsciously, serving as rather implicit tools for product-packaging communication (e.g., Becker et al., 2011; Dijksterhuis et al., 2005; van Ooijen et al., 2017). Shifting from conventional plastic materials to more ecological substitutes, the packaging can present various implicit cues carrying distinctive sensory properties. For instance, biodegradable and compostable materials differ in opacity, color, and tactile properties compared to conventional plastics (Vedove et al., 2021; Guillard et al., 2018; Sirvi¨o et al., 2013). Recycled plastics, such as rPET, can subtly manifest diverse hues (Yam, 2010). Biomaterials, like Polylactic Acid, produce distinctive sounds when handled (Diaz et al., 2016).

In sustainable packaging design, companies can follow two main strategies in targeting these implicit cues: they can either follow an imitation or differentiation strategy. The imitation strategy involves mimicking the features of conventional packaging (e.g., transparency of the plastic), and concealing the exclusive characteristics of eco-materials (e.g., the opacity level of a biodegradable packaging) (Magnier & Schoormans, 2015; Granato et al., 2022). An example is the new Coca-Cola bottle, which incorporates plant-based materials through the innovative PlantBottle® technology, while visually appearing indistinguishable from the conventional version (Magnier & Schoormans, 2015). The imitation strategy has been commonly employed and practiced in the food and packaging industry (Guillard et al., 2018; Sirviö et al., 2013), due to concerns about whether new packaging materials would negatively impact consumer perception and adoption (Polyportis et al., 2022; Karana et al., 2018; Magnier et al., 2016). For instance, certain studies have revealed that the transparency of food packaging (vs. opaque packaging) typically associated with conventional plastic enhances perceptions of product trustworthiness, facilitates quality evaluation, and results in higher purchase intention and product choice (Billeter et al., 2012; Simmonds & Spence, 2017). Furthermore, existing literature underlines the impact of packaging typicality on product categorization and subsequent evaluations (Schoormans & Robben, 1997). By imitating conventional plastic packaging, companies can help consumers make quick, easy decisions. Novel designs that deviate from the prototypical design in the category can potentially harm perceived usability (Mugge & Dahl, 2013; Krah et al., 2019b). The imitation strategy can be effective in reducing consumer reluctance to try new eco-materials by

signalling to consumers a certain degree of familiarity or similarity with what consumers have been used to. However, without distinguishable packaging properties, consumers might not be able to categorize it as sustainable packaging and fail to perceive the positive environmental benefits it offers (e.g., Granato et al., 2022; Krah et al., 2019; Magnier & Schoormans, 2015). The study conducted by Taufik et al. (2020) revealed an interesting paradox regarding compostable bio-based plastic packages: Although mainly compostable bio-based plastic packages have strong environmental appeal to consumers, they would dispose of compostable and biodegradable plastic in the wrong waste bin due to their lack of familiarity with the packaging following imitation strategy.

The differentiation strategy, on the other hand, aims to highlight the distinctive sensory properties of eco-friendly packaging materials to act as "reminders for newness and distinctiveness" (Lindh et al., 2016; Rundh, 2009, 2016). This approach entails designing packaging that stands out from conventional packaging by emphasizing features such as texture, color, sound, and opacity, that differentiate themselves from conventional looking imitating the status quo of plastics. For example, Carlsberg's Fiber Bottle, a plant-based and fully recyclable packaging, presents a paper-like appearance and tactile feel. Numerous studies have indicated that consumers favor novel products when newness, unfamiliarity, and originality can alleviate boredom and saturation effects (Mugge and Dahl 2013; Creusen & Schoormans, 2005; Martindale, Moore, & Borkum, 1990). The differentiation strategy can effectively capture consumer attention and appeal to environmentally conscious consumers, setting a product apart from its competitors (Magnier & Schoormans, 2015; Steenis et al., 2017). It has also been found to evoke a higher evaluation of the brand's social responsibility (Magnier & Schoormans, 2017). Moreover, the distinctive implicit packaging properties could effectively communicate its environment-friendliness to consumers, such as green color (Parguel et al., 2015), fiber-based material/ecological appearance (e.g., Magnier & Schoormans, 2015; Magnier & Schoormans, 2017; Krah et al., 2019b; Magnier et al., 2016; Lindh et al., 2016). Granato et al. (2022) discovered that meaningful implicit cues (such as green color, recycled/craft look, and opaque material) rather than meaningless implicit cues (sound and touch), can lead to high salience and perception of packaging sustainability. Additionally, Magnier & Schoormans (2015) demonstrated in their research that packaging with an ecological appearance (molded-pulp bottle) could positively influence consumers' affective attitude and purchase intention compared to the conventional-looking packaging (plastic bottle). However, as Karana et al. (2018) proposed, there is a need for a deeper understanding of how the newness of a bio-based material should be made obvious in an application, or whether it should be used as a surrogate material that goes unnoticed, in order to promote wider acceptance of these emerging materials.

Given the potential risks associated with both sustainable packaging design strategies in consumer perception and behavior, the present study seeks to investigate whether following a differentiation strategy or adopting an imitation strategy in eco-packaging design could lead to increased sustainability perception and actual sustainable behaviors.

The current study hypothesizes that packaging design following the differentiation strategy, which highlights its distinctive sensory characteristics, would serve as implicit reminders to trigger automatic sustainability association. This, in turn, is expected to lead to increased sustainability perception and "nudge" consumers towards subsequent sustainable disposal behaviour. In contrast, packaging employing an imitation strategy with no implicit reminder may not effectively convey its sustainability attributes. Consequently, consumers may perceive it as similar to conventional counterparts, resulting in a lower perception of sustainability and potentially leading to less proper packaging disposal. Therefore, the following hypotheses are formulated:

H1a: Packaging that follows a differentiation strategy be will be perceived as more sustainable than the packaging that follows an imitation strategy.

H1b: Packaging that follows a differentiation strategy will lead to more sustainable disposal behavior compared to packaging that follows an imitation strategy.

2.2. Explicit packaging cues for sustainable responses: long vs short supply chain through packaging visualization and claims

2.2.1. Influence of explicit cues on sustainable consumer responses

In the realm of packaging design, explicit cues refer to the direct and observable information that is purposely provided to consumers (e.g., Granato et al., 2022; van Ooijen et al., 2017). They are often regarded as tangible and associated with deliberate cognitive processing (Magnier & Schoormans, 2015). They can be intentionally used as a diagnostic tool for consumers to evaluate the product qualities and benefits (Roberto et al., 2012; van Ooijen et al., 2017). Explicit cues can take a variety of forms, encompassing both verbal messages (e.g., claims, statements, description) and visual elements (e.g., eco-labels, images, and photographs) (e.g., Granato et al., 2022; Wang et al., 2022b; Magnier & Schoormans, 2017; Magnier & Schoormans, 2015). The visual explicit cues usually need to be accompanied by explicit verbal information to be fully understood by consumers (e.g., Magnier & Crié, 2015).

Environmental claims are one form of the verbal cues. These claims are declarations made by businesses about the features or attributes of their products and services that benefit the environment. They can discuss how goods are created, packaged, distributed, used, consumed, and/or disposed of (OECD, 2011). A body of literature suggests that packaging environmental claims have the potential to increase perceived packaging eco-friendliness (Magnier & Schoormans, 2017; Magnier & Schoormans, 2015), enhance evaluation of the social responsibility of the brand (Magnier & Schoormans, 2017), and drive sustainable behaviour, particularly purchase intention (e.g., Magnier & Schoormans, 2015; Aagerup et al., 2019). In addition to the verbal information, visual elements, such as eco-labels, can also directly highlight packaging's sustainability traits, thus enhancing sustainability perception (Granato et al., 2022), and purchase intention (Wang et al., 2022; Lestari et al., 2020; Tian & Kong, 2012). Such visual cues can attract visual attention (Eelen et al., 2015) and usually appear in combination with corresponding text to ease information processing, facilitate comprehension and address confusion (Wang et al., 2022; Rihn et al., 2019).

The combination of implicit and explicit cues increases the amount of arguments provided by the package and as such increases its persuasive impact by giving individuals additional information to consider (Eagly & Warren, 1976; Petty & Caccioppo, 1984). When explicit cues are integrated into packaging following a differentiation strategy, these cues can highlight implicit design elements that signal sustainability. This can help categorisation (Magnier & Schoormans, 2015) and therefore make it easier for consumers to choose a more sustainable packaging alternative. Moreover, the significance of explicit cues becomes even more pronounced when packaging follows an imitation strategy. Despite their intention to reduce environmental impacts, these packages can be easily misunderstood due to their conventional appearance. By incorporating explicit cues into packaging with conventional characteristics (e.g., materials resembling plastic), the environmental friendliness of the packaging can be effectively communicated. However, explicit cues such as eco-labels and environmental claims are often miscomprehended, leading to skepticism about "greenwashing" practices (e.g., Magnier & Schoormans, 2015).

Some previous research has revealed consumers' lack of understanding and limited knowledge relating to packaging messaging such as symbols, labels, and claims (e.g., Norton et al., 2023; Taufik et al., 2020). Moreover, the use of different label schemes across various countries adds to the confusion (Boesen et al., 2019). This underlines the need for further exploration of effective communication strategies in formulating explicit packaging information, in order to communicate packaging environment-friendliness in a way that consumers easily understand and guide consumers to make informed disposal choices (Taufik et al., 2020). While a majority of the research has primarily focused on the effect of the presence of certain explicit cues (e.g., environmental claims present/absent), there has been limited investigation into specific strategies on how to craft these cues to promote sustainable consumer responses (Aagerup et al., 2019; Schmuck et al., 2017; Spack et al., 2012). For instance, Aagerup et al. (2019) examined how rational and emotional green packaging claims influence consumers' purchase intention for organic coffee. Their findings revealed that consumers preferred products with green claims over those with neutral claims, and products with emotional green claims to those with rational green claims. To address this gap, the current research seeks to develop a packaging communication tool that shapes packaging sustainability perception and stimulates sustainable consumer behavior.

In summary, explicit cues play a crucial role in communicating sustainability, which is often considered a credence attribute of packaging. Packaging credence attributes pertain to the characteristics or features of the packaging that consumers cannot readily observe or verify with their own eyes, before or after purchase or consumption (Darby and Karni, 1973). By incorporating explicit cues, packaging can highlight the sustainability-related credence attributes of the packaging in a clear and transparent manner, thereby enhancing consumer

perception and preferences and facilitating environmentally conscious disposal behaviour. This becomes especially relevant in today's context of detachment and disconnection from nature, which can make consumers less sensitive and sometimes blind towards recognition of sustainability (e.g., Zhang & Jian, 2022; Ives et al., 2018; Louv, 2009; Conn, 1998).

It has been widely acknowledged that in the past, humans were more closely connected to nature, both physically and psychologically, compared to individuals living in industrialized nations today (Melson, 2005; Warren & Shepard, 1997; Shepard, 1993). Some factors contributing to nature disconnection include urbanization (Cumming et al. 2014), reduced access to green spaces (Lin et al. 2014), changing social norms and perceptions (Valentine and McKendrick 1997), and rise in electronic media (Pergams and Zaradic 2006). This concept of diminishing nature connection has been thoroughly explored in the literature on nature connectedness, where a number of studies have demonstrated that the greater the perceived distance consumers feel from nature, the less sensitive they are to environmental issues (Schultz, 2000). Conversely, as individuals' sense of closeness to nature increases, so does their empathy, willingness to help (Mayer & Frantz, 2004), and intention to engage in ecological consumer behavior. The concept of connectedness to nature will be further elaborated in the following section.

2.2.2 Psychological connectedness or distance to nature

According to the biophilia hypothesis (Kellert and Wilson, 1993), humans possess the biological need to connect with, and belong to, the wider natural world. The concept of perceived connectedness or distance to nature has gained increasing attention in the field of environmental psychology and sustainability research. Connectedness to nature (CN) refers to individuals' sense of oneness with, and belonging to their natural environment (Martin & Czellar, 2016; Mayer & Frantz, 2004; Restall & Conrad, 2015; Tauber, 2012). Individuals with higher nature connectedness would expend their sense of self to include the natural world, thus experiencing behaviour leading to destruction of this world as self-destruction (e.g., Schultz, 2002a; Metzner, 1999; Roszak, 1995). A stronger feeling of connectedness to nature correlates with a lower likelihood of harming the natural environment, and a stronger tendency to support pro-environmental behaviour. Those who are more strongly connected to nature demonstrate greater environmental concerns and a stronger empathy for nature, as well as an increased intention to protect the environment and exhibit pro-environmental behaviour (Mayer and Frantz, 2004, Dutcher et al., 2007; Howard, 1997).

The sense of connection to nature has been linked to a range of pro-environmental outcomes, including green values (e.g., Haws et al., 2014), greater biospheric concern (e.g., Mayer & Frantz, 2004; Schultz, 2001; McConnell & Jacobs, 2020b), and a greater intention to engage in pro-environmental behaviors (Martin et al., 2020b; Dong et al., 2020; McConnell & Jacobs, 2020b; Whitburn, Linklater, & Milfont, 2020; Otto & Pensini, 2017; Tam, 2013a). For instance, Martin et al. (2020) uncovered that nature connectedness was positively related to self-reported household pro-environmental behaviors (e.g., recycling, energy conservation, green consumption) and nature conservation behaviors (e.g., supporting conservation organizations, participating in environmental campaigns). Dong et al. (2020) found that connectedness to nature has direct positive effects on self-reported green purchasing and recycling, and exerts indirect positive effects on sustainable consumer behavior such as reusability through the mediating role of love of nature. Similarly, Dutcher et al.'s (2007) study highlighted that a strong connection with nature maintained a significant and positive correlation with environmental concern. This translated into eco-friendly behaviors such as recycling, utilizing public transportation, and purchasing organic products.

The level of connectedness to nature can be increased through nature exposure (e.g., Mayer et al., 2009). Nature exposure has traditionally involved direct exposure to real natural environments, such as visits to natural spaces, contact with plants and animals, and engagement in outdoor activities (Pirchio et al., 2021; Martin et al., 2020; Rosa et al., 2018; Mayer & Frantz, 2004). However, recent research has examined the effects of indirect nature exposure, where participants are exposed to nature through various media, such as videos (e.g., nature-based TV and radio programmes), pictures, or virtual reality (e.g., Coughlan et al., 2022; McAllister et al., 2017; Nadkarni et al., 2017; Tanja-Dijkstra et al., 2018; Mayer et al., 2009).

Although previous research has highlighted the positive impact of nature connectedness on sustainable consumer behaviour, there appears to be a gap in the research regarding its application in the context of design. Specifically, there is limited research which explores how design interventions can effectively evoke this sense of connection (vs distance) to nature and potentially prompt more sustainable behaviours. However, inducing nature

connectedness through packaging design is challenging due to the abstractness of the "nature" concept. Moreover, packaging design, constrained by its space for conveying messages and the brief window of consumer attention it typically receives, may not provide an adequate platform to communicate such a complex notion effectively. Additionally, the impact of packaging design on fully immersing consumers in nature through text and images alone is inherently limited, given the constraints of the medium. Therefore, in order to make it more relevant and practical for on-packaging communication, the concept of "connectedness to the origin of the supply chain" was proposed.

2.2.3 Manipulating connectedness to the origin of the supply chain through packaging communication

In the context of packaging design, the concept of nature can be reinterpreted to encompass packaging-related aspects, such as the origin of the supply chain, the raw materials, and the starting point of the production process. This refocusing is crucial because, throughout everyday life, countless instances exist when consumers, often unconsciously, fail to associate the final products they consume with their raw material sources. For example, consumers may not be fully aware that beef comes from cows, leather in their shoes or bags comes from animal hides, t-shirts come from cotton plants, paper comes from trees, or that a compostable material is made from corn.

Building upon the concept of nature connectedness and this common disconnect between consumers and the source of products inspired the exploration of a new concept: connectedness to the origin of the supply chain. Extending the existing concept of nature connectedness, this novel idea seeks to reduce the psychological distance or connectedness between consumers and the starting point of the packaging supply chain. By doing so, consumers can experience a stronger sense of connection to the source of the materials used in packaging. This refined concept offers greater practicality and relevance in the context of packaging design, as it allows for a more targeted and tailored focus on the origin of the supply chain of specific to sustainable packaging alternatives (e.g., recycled, compostable, recyclable), rather than the broad and vague notion of nature.

Specifically, explicit cues, such as packaging visualization and claims, can be used to portray a packaging supply chain from the packaging raw material to the final product-packaging. This representation has the potential to influence the psychological distance or connectedness consumers feel towards the origin of the supply chain. Psychological distance refers to how distant or close individuals perceive an event or object to be in terms of time, space, social relationships, and hypotheticality (Trope & Liberman, 2010). In the scope of this research, the length of the supply chain displayed on packaging could alter consumers' psychological distance, subsequently affecting consumers' sense of connection or distance with the origin of the supply chain on both temporal and spatial dimensions.

When packaging visualizations and claims depict a long supply chain — one that includes numerous stages of industrial processing and is represented by an elongated line symbolizing the supply chain — consumers might feel a greater distance from the natural source and an increased detachment from the raw material. The spatial distance perceived by consumers is magnified due to the extended distances to the raw material and production facilities. At the same time, the temporal distance is amplified due to the prolonged duration of the production processes. Consequently, consumers might perceive the packaging as less sustainable due to its extensive processing and the numerous industrial stages involved. The strong distance and disconnection they feel toward the source of the packaging and its inherent natural environment could induce indifference and reduce motivation to engage in ecological behaviours to conserve and protect nature. This sense of distance from the origin of the supply chain could consequently result in less environmentally responsible disposal practices.

On the other hand, packaging visualizations and claims portraying a short supply chain — tracing a only several number of processing steps from raw packaging material to the final product and represented by a shorter line indicating the supply chain — can decrease the perceived spatial and temporal distances between consumers and the origin of the supply chain. This reduction in psychological distance fosters a closer connection with the origin of the chain, which could enhance the perceived sustainability of the packaging. This increased sense of connectedness may evoke a stronger empathy for nature, as well as an elevated intention to protect the environment, thereby driving sustainable disposal behaviour.

Consequently, the following hypotheses are formulated:

H2a: Packaging visualization and claims that depict a short supply chain will be perceived as more sustainable, compared to those that depict a long supply chain.

H2b: Packaging visualization and claims that depict a short supply chain will lead to more sustainable disposal behaviour, compared to those that depict a long supply chain.

2.3. The interplay of implicit and explicit cues on sustainable responses

Explicit and implicit packaging cues are usually employed in combination to effectively shape consumer perception and guide their behavioural responses (van Ooijen et al., 2017). Previous research has discovered certain interaction effects between implicit and explicit cues on consumer perception, such as perceived packaging sustainability (Granato et al., 2022; Magnier & Schoormans, 2015) and perceived packaging expensiveness (Krah et al., 2019). For instance, Granato et al. (2022) delved into how explicit (environmental labels) and implicit packaging design cues (packaging sensory properties) and their combination can be used to positively affect sustainability salience and perception. Their findings demonstrated that the addition of explicit cues to previously meaningless reminders resulted in a significant increase in sustainability perception of the packaging, compared to when explicit cues were added to cues that were already meaningful. Drawing on these findings, the present study intends to investigate how particular explicit cues, which demonstrate the length of the supply chain, can influence sustainability perception and disposal behaviour when combined with implicit cues.

A differentiation strategy, characterized by distinctive sensory properties, serves as a distinctive reminder signalling sustainability (Granato et al., 2022). When combined with the depiction of a short supply chain on packaging, it is likely to enhance the packaging sustainability perception. This effect can be attributed to the congruence between the packaging's ecological attributes and the minimal processing stages represented in the supply chain. When exposed to a short supply chain, individuals would feel more connected and psychologically close to the raw material and the natural world, leading consumers to favour packaging that looks more congruent with the chain. Conversely, when paired with a long supply chain, an inconsistency emerges between the packaging's inherent ecological attributes and the complex production process the supply chain signifies. This incongruity can engender confusion and mistrust, consequently diminishing the perception of sustainability.

An imitation strategy, which mirrors conventional materials, can often make it challenging for consumers to discern the sustainability trait of the packaging (Magnier & Schoormans, 2015; Steenis et al., 2017). When it is coupled with a long supply chain, the packaging might be perceived as more sustainable as this is coherent with the highly industrialized process. Given the multitude of processing steps, sustainable packaging (e.g., compostable packaging, recycled packaging) becomes similar to plastic, which justifies its typical characteristics and makes consumers realize the technology and efforts the company invests in the packaging transformation. Furthermore, since the individual is psychologically distant from the raw material and natural world, there's a likelihood of preferring the "more artificial/processed" packaging that imitates conventional plastic – the status quo. On the contrary, when this imitation strategy is combined with a short supply chain, consumers may interpret the explicit cues as a form of "greenwashing". This is due to the perceived incongruity between the perceived short distance to the packaging source and the highly-processed appearance (Nyilasy et al., 2014). This misalignment can lead to scepticism and consequently lower sustainability perception (Magnier & Schoormans, 2015; Parguel et al., 2011).

Given these considerations, the subsequent hypothesis is developed:

H3a: When packaging follows a differentiation strategy, consumers will perceive the packaging as more sustainable when a short supply chain is presented on packaging, compared to when a long supply chain is presented.

H3b: When packaging follows an imitation strategy, consumers will perceive the packaging as more sustainable when a long supply chain is presented on packaging, compared to when a short supply chain is presented.

Similarly, when packaging is designed in the differentiation strategy and paired with a short supply chain, consumers would perceive the packaging as more sustainable and value the distinctive packaging as something worth preserving. They may become more aware of their actions' impact on the environment and pay attention to their disposal decision. On the other hand, when packaging is designed in the imitation strategy and coupled with a long supply chain, the increased perceived eco-friendliness of the packaging and an understanding of the intricate production journey can motivate consumers to engage in more correct packaging disposal.

Therefore, the hypotheses are developed as follows:

H4a: When packaging follows a differentiation strategy, consumers will dispose of the packaging more sustainably when a short supply chain is presented on packaging, compared to when a long supply chain is presented.

H4b: When packaging follows an imitation strategy, consumers will dispose of the packaging more sustainably when a long supply chain is presented on packaging, compared to when a short supply chain is presented.

2.4. The mediating role of connectedness to the origin of the supply chain on sustainable consumer responses

As previously outlined, explicit cues that depict a long supply chain can evoke feelings of distance and disconnection from the origin of the supply chain, resulting in lower perceived sustainability and less eco-friendly disposal behaviour. Conversely, explicit cues which illustrate a shorter supply chain could foster a stronger connection to the origin of the supply chain, enhancing perceived eco-friendliness and promoting more desirable disposal actions.

Simultaneously, implicit cues, embodied through packaging design strategy, may also stimulate distinct associations with the origin of the supply chain. Packaging that follows an imitation strategy may not explicitly reveal the ecological nature of the material, leading to a reduced connection with the origin of the supply chain and, subsequently, lower sustainability perception and less eco-friendly disposal behaviour. In contrast, packaging that adopts a differentiation strategy can induce an enhanced sense of connectedness with the raw material and its supply chain, leading to increased sustainability perception and more eco-conscious disposal behaviour.

Additionally, the combination of implicit and explicit cues can potentially lead to varying levels of connectedness, thus exerting a significant impact on consumer sustainability perception and disposal behaviour of the packaging.

Thus, the following hypotheses are proposed:

H5a: Feeling of connectedness to the origin of the supply chain will mediate the relationships between packaging design strategy, length of the supply chain, and sustainability perception.

H5b: Feeling of connectedness to the origin of the supply chain will mediate the relationships between packaging design strategy, length of the supply chain, and disposal behaviour.

2.5. The mediating role of perceived consumer effectiveness on disposal behavior

Perceived consumer effectiveness (PCE) is an important psychological construct in consumer behaviour research. It refers to an individual's belief about the effectiveness of their actions in contributing to the solution of a particular problem (Ellen et al., 1991b). The common thread is that subjects' actions and/or intentions are affected by the degree to which they believe the occurrence or aversiveness of an event can be affected by their action(s) (Thompson, 1981). In the domain of sustainability research, PCE relates to the consumer's belief in his or her personal efforts to contribute to solving environmental issues through specific behaviours (Hanss & Doran, 2022; Roberts, 1996). This concept has been found to be a significant predictor of ecological concern (Kinner, et al.,1974) and patterns of responsible ecological consumption (Balderjahn, 1988). Furthermore, previous studies have revealed that PCE is positively related to environmental attitude (Kim, 2002) and various sustainable consumer behaviours, such as green consumption (e.g., Kim & Choi, 2005; Verhoef 2005; Aoyagi-Usui & Kuribayashi, 2001), energy conservation (e.g., Allen 1982), and waste recycling (e.g., Izagirre-Olaizola et al. 2015). In terms of disposal behaviour, consumers who believe their actions in waste management can have a considerable effect on the environment are more likely to exhibit sustainable disposal behaviour (Cheung et al., 1999). They tend to segregate waste, recycle and compost more than those who do not perceive their actions as impactful (Straughan & Roberts, 1999).

In the current study, we propose to examine the role of PCE as a mediator in the relationship between implicit and explicit packaging design cues and disposal behaviour. Different packaging design strategies can potentially influence PCE, which subsequently impacts sustainable disposal behaviour. The packaging following the imitation strategy may induce lower perceived consumer effectiveness, as consumers perceive the packaging as aligning with existing consumption patterns and requiring minimal changes. This could result in less sustainable disposal practices. In contrast, when a differentiation strategy is employed, it may augment perceived consumer effectiveness, as consumers perceive the packaging as unique and environmentally friendly, leading to a stronger

belief in their ability to make a positive impact on sustainability. This enhanced sense of effectiveness may encourage more environmentally conscious disposal behaviour.

The length of the supply chain depicted on packaging may also significantly influence consumers' perceptions and beliefs regarding the effectiveness of making sustainable choices. A short supply chain may enhance consumers' sense of responsibility and efficacy in the packaging supply chain, leading to higher perceived consumer effectiveness and more positive disposal behaviour. To be specific, feeling close to the starting point of the chain and the fewer steps included in the whole cycle could potentially make consumers feel that they play a significant role in the entire packaging life cycle. The effort of correct disposal counts more and contributes significantly to the natural environment and animal welfare. On the other hand, a long supply chain that demonstrates a long line, with multiple production steps in between, may lead consumers to believe their individual actions have a limited impact on the environment, and their disposal effort only counts as one single minor step in the whole chain and can hardly contribute to the overall sustainability. This perspective can lead to reduced perceived consumer effectiveness, thereby obstructing the decision to engage in sustainable disposal behaviour.

Interestingly, an opposite effect may also occur. When presented with a short supply chain, consumers may perceive the effort of sustainable behaviour to be substantial considering their action is one of the few steps involved in the whole supply chain, resulting in lower PCE and less sustainable disposal. With a long supply chain, consumers may believe that their following actions, serving as the last step in closing the packaging loop, are crucial in the packaging life cycle. Since there are so many steps involved, their action requires less effort, leading to higher PCE and more responsible disposal. These contrasting effects underscore the need for further exploration in understanding the underlying mechanisms driving these effects.

Based on these assumptions, the following hypothesis is proposed:

H6: The perceived consumer effectiveness will mediate the relationships between packaging design strategy, length of the supply chain, and disposal behaviour.

To sum up, a conceptual model is illustrated to demonstrate the relationship between implicit and explicit cues and their effect on sustainability perception and disposal behaviour of the packaging (Fig. 1).

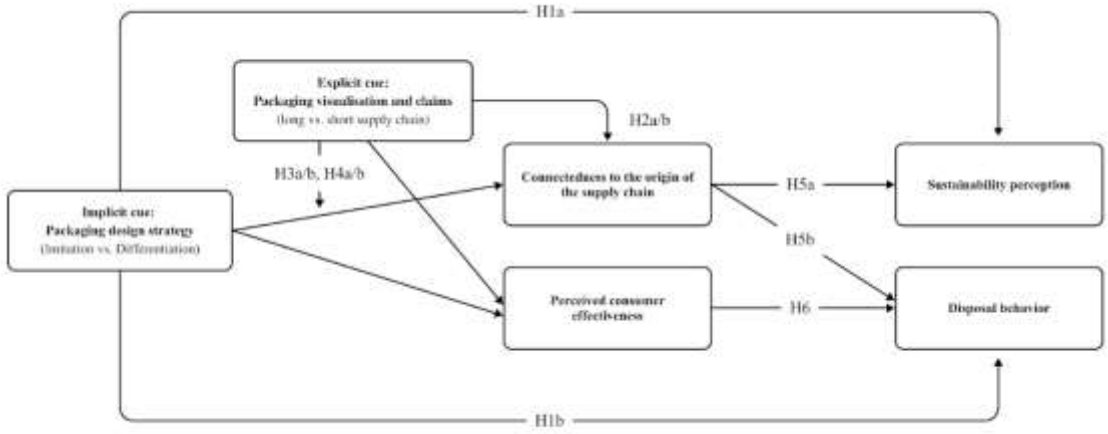


Fig. 1. The research model

3. Method

3.1. Participants and design

To achieve a sufficient power (>= 0.80) for detecting a medium effect size (f = 0.25) at a significance level of 0.05, a minimum sample size of 179 participants was calculated (G*Power 3) (Faul et al., 2007). A total of 275 participants from the TU Delft IDE faculty were recruited for the study. After excluding participants who did not complete all the questions in the questionnaire, a final sample size of 252 participants (50.4% female, Mage = 22.39 years) was used for data analysis. In terms of packaging disposal, 8 participants were omitted because they

left with the tray in hand or left it on the table and did not dispose of it on the way out, leaving 244 usable observations (51.2% female, Mage = 22.34 years). The sample in this study comprised a diverse mix of students, with 65.9% of participants being Dutch and the remaining 34.1% constituting international students (i.e., non-Dutch). The study was pre-registered and the preregistration details can be accessed on OSF (Open Science Framework) at the following link: osf.io/b6fy3.

The participants were invited to take part in a biscuit-tasting session to evaluate a new biscuit product as well as its packaging developed by a food company. They were randomly assigned to one condition in a 2 (packaging design strategy: imitation vs. differentiation) by 2 (packaging visualization and claims: long vs. short supply chain) between-subjects design. The sample sizes across conditions ranged from 55 to 64 participants. The estimated time required for each participant to complete the experiment was around 10 minutes. Upon completion of the experiment, participants were offered a chocolate bar as a thank-you gift.

3.2. Stimuli

The product category chosen for the experiment was a one-bite biscuit product. This choice was made because biscuits are representative of the snack food category that typically comes in primary packaging, making them a relevant product category for investigating the effect of packaging claims on disposal behaviour in a real-world context. Furthermore, the single-bite size of biscuits ensured that the disposal decision would be influenced solely by the explicit cues rather than the remaining food scraps in the packaging. Additionally, biscuits, as a dry product, are less likely to leave any stains or residue on the packaging, eliminating the potential influence of such factors on disposal behaviour. The biscuit product chosen for the experiment is the Cranberry Butter Cookies manufactured by RIOBA, a leading coffee supplier that offers a range of coffee and tea products owned by the Dutch international warehouse club Makro. Although RIOBA offers a variety of food products, including cookies, brownies, milk, and chocolate, these items are less well-known compared to their coffee products. This particular biscuit is available in a single-bite size with a plain biscuit appearance and has a quite distinctive flavour. Since the product is not currently available in major supermarket chains in the Netherlands such as Albert Heijn or Jumbo, it is reasonable to assume that the research audience, predominantly composed of Dutch students, would be unfamiliar with it. This could lead to a focus on product evaluation.

In the study, participants were provided with a packaging tray containing the biscuit samples to interact with. The provided packaging was compostable and followed either an imitation or differentiation design strategy. The differentiation packaging was characterized by a white tray with a low level of opacity and a non-smooth tactile feel, setting it distinctly apart from conventional plastic packaging. In contrast, the imitation packaging resembled the typical appearance and sensory properties of transparent plastic material (Fig. 2).

In the questionnaire, participants were presented with images showcasing the final packaging design. The mock-up images were created using Photoshop to demonstrate the packaging design for each experimental condition. The final packaging design comprised the biscuits, a biscuit tray similar to the packaging tray provided in the study, serving as the primary packaging, and clear wrapping serving as the secondary packaging. The opacity and colour of the clear packaging were adjusted for the groups with the differentiation strategy in order to simulate the compostable packaging bag in reality. The images provided participants with a comprehensive view of the final packaging design, including both a front view and a side view.

The front of the final packaging featured additional product details, such as a fictitious brand name "TreatTaste," the product name, flavour, volume, and a compostable eco-label (Fig. 3). The side view of the packaging displayed on-packaging information, including visualizations and claims that highlighted either a short or long supply chain (Fig. 4).

Fig. 2. Packaging tray: (Left) packaging following an imitation strategy; (Right) packaging following a differentiation strategy

Fig. 3. Front view of the final packaging design: (Left) Packaging following an imitation strategy; (Right) Packaging following a differentiation strategy

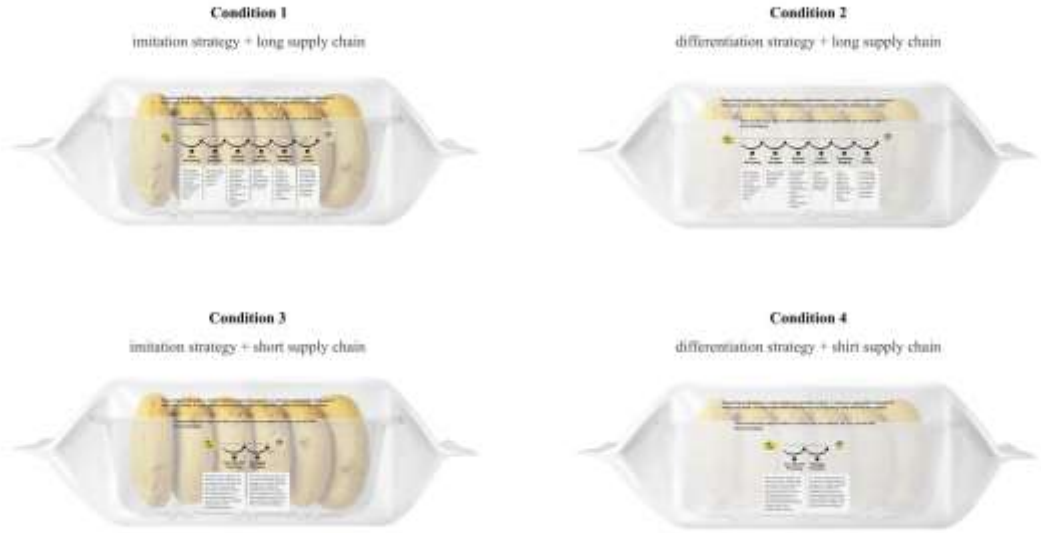
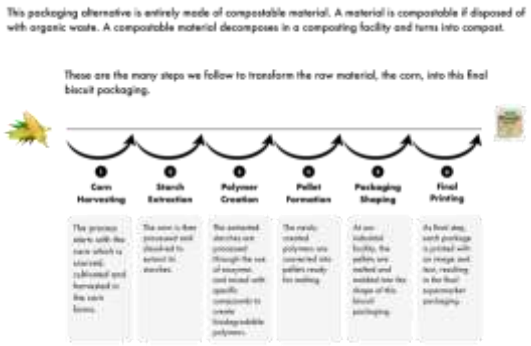
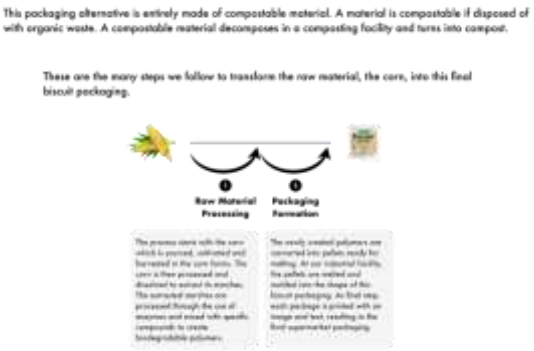


Fig. 4. Side view of the final packaging design: (Condition 1: imitation + long supply chain; Condition 2: differentiation + long supply chain; Condition 3: imitation + short supply chain; Condition 4: differentiation + short supply chain)

Table 1 Packaging visualization and claims: (Left) long supply chain; (Right) short supply chain

Long supply chain	Short supply chain
	

To minimize interference from irrelevant design elements and better highlight the packaging information, a printed paper with the manipulation of the long vs short supply chain was adhered to the table. The packaging information encompassed several components. Firstly, a brief description introducing the compostable biscuit packaging and the correct way of disposal, which remained consistent across both conditions (long vs. short supply chain). Additionally, a visual representation was presented, depicting step-by-step production processes. Arrows were used to connect each stage, effectively portraying the supply chain from the plant source to the final packaging. Complementary titles and text were placed beneath each step, offering in-depth explanations for the manufacturing methods employed at each stage of the process.

The manipulation of the supply chain length involved three key components: number of steps explained in the claims (6 vs. 2), arrows linking each step in the supply chain (6 vs. 2), and the length of the chain (long vs. short). In the condition showcasing a long supply chain, the packaging claim describes and depicts six stages from the raw packaging material to the final packaging. This is visually demonstrated by multiple arrows that trace back to the starting point of the chain, with a longer line representing the supply chain. It could potentially enhance the sense of distance and alienation consumers may feel from the raw materials and its natural environment. Conversely, in the condition that showcases a short supply chain, the same information is presented in the claim but grouped into two stages. This is visualized through fewer arrows leading back to the starting point, coupled with a shorter line symbolizing the supply chain. As a result, consumers may perceive a more intimate connection to the starting point, which represents the packaging source and origin of the chain (Table 1, details in Table A.1, Appendix A).

3.3. Procedure

The study was conducted in a computer room located in the faculty of Industrial Design Engineering at TU Delft. Upon entering the lab, participants were randomly assigned to one of the four conditions in a two-by-two between-subject design. In each condition, participants could find a packaging tray that either followed the imitation strategy (transparent tray) or the differentiation strategy (opaque white tray) on the desk with a biscuit inside. Each tray was labelled with a unique code representing the assigned condition, along with a series number corresponding to each participant, thereby establishing a clear link between the tray and the specific participant. Next to the packaging and the biscuit, a paper demonstrating one of the two conditions of the length of the supply chain (long vs. short) was affixed to the desk. Participants were provided access to a Qualtrics questionnaire on the computer in front of them, which displayed the questions and images of the final packaging design corresponding to their assigned conditions. Prior to participants' arrival, the same respondent codes labelled on the bottom of the packaging prototypes were entered into Qualtrics to assign participants to their respective conditions. To limit social influence at the point of disposal, participants entered the laboratory individually and commenced the study at their own pace, allowing for staggered completion times (Fig. D.1, D.2, D.3 in Appendix D for the research setup).

Before starting with the study, participants were required to read and agree to the informed consent incorporated into the Qualtrics questionnaire. Following this, participants were presented with an image of the final packaging design, providing an overview of the entire product, including the quantity of biscuits and additional packaging information. It was clarified in the image that the tray, and biscuits displayed in the final packaging design were similar to the ones presented on their desks (Fig. 5, for other conditions see Table A.1, Appendix A). A zoomed-in view of the packaging information was printed on the desks for reference (Fig. 6). Participants were then instructed to first take a look at the packaging tray on the desks, hold it in their hands and try to get an impression of it. Subsequently, they were asked to spend some time reading and processing the information on the paper. Afterwards, participants were asked to eat the whole biscuit and respond to some questions regarding their perception of the product, including evaluations of tastiness, naturalness, and healthiness. Furthermore, an open-ended question invited participants to share any additional thoughts or feedback they had about the biscuit product.

In the following section, participants were requested to re-evaluate the other part of the packaged product: the packaging itself. They were once again provided with the final packaging design and asked to hold the prototype in their hand, turn it around and try to engage with it as much as possible. Participants were then prompted to rate the appeal of the packaging tray. Next, they were directed to revisit the packaging information provided on the desk and instructed to carefully read it again. Afterwards, participants were asked to select the emotions they experienced while interacting with the packaging prototype and engaging with the given information. A thought listing task followed, wherein participants recorded the reasons behind their emotions, along with any thoughts or impressions that arose while examining the packaging. They were then presented with a question to measure their perceived sustainability of the packaging. Subsequently, participants responded to a series of questions assessing their state level of nature connectedness. The perceived consumer effectiveness was evaluated through two questions. Towards the end of this section, participants were asked to complete a manipulation check regarding the packaging information.

In the subsequent section, participants were asked to answer a few questions pertaining to their environmental concern, brand attitude, and purchase intention of the product. Additionally, they were presented with some demographic questions related to their age, gender, nationality, residence city. Lastly, an open-ended question provided an opportunity for participants to share any additional thoughts or comments they wished to express.

Fig .5. Final packaging design shown in Qualtrics (example: imitation + long supply chain)

Fig .6. Zoomed-in view of the packaging information displayed on the paper taped to the desk

In the end, participants were asked to leave their desks empty, ready for the next participants, and throw away the tray on their way out (See the Qualtrics questionnaire Fig. B.2, Appendix B). A set of bin stations, comprising four bins (paper, organic, plastic, and general) arranged from left to right as prescribed by the bin producer, was placed at the left side of the exit to measure the disposal behaviour of the packaging (Fig. D.2, Appendix D). Participants were not aware and informed of this measure.

3.4. Measures

Participants were first presented with the image of the final packaging design and instructed to interact with the packaging tray and then read the information on the table. Following this, they would eat the given biscuit and proceed to answer the following questions.

Perceived tastiness of the product: Perceived tastiness was measured on a 7-point scale: "*To what extent do you find the biscuit tasty*?" (1 = not tasty at all, 7 = very tasty) (De Temmerman et al., 2021b).

Perceived naturalness of the product: Perceived naturalness was measured on a single item 7-point scale: "*To what extent do you find the biscuit natural?*" (1 = not natural at all, 7 = very natural) (Magnier et al., 2016).

Perceived freshness of the product: Perceived freshness was measured on a single item 7-point scale: "*To what extent do you find the biscuit fresh?*" (1 = not fresh at all, 7 = very fresh) (Simmonds et al., 2018).

Product attribute evaluation (open-ended): As a filler question, participants were asked to provide general feedback on other attributes of the product using an open-ended format: "*Do you have any additional thoughts or feedback about the product? (e.g., size, shape, crunchiness, etc). If so, please write them here.*"

Now here, after they saw and replied to these questions, I would show them again the final packaging and ask them to engage with the packaging tray.

Tray appeal: Tray appeal was assessed through a self-formulated single-item 7-point scale with the following question: "*To what extent do you find the tray appealing?*" (1 = not appealing at all, 7 = very appealing). This measure was included to ensure that the packages did not differ significantly in their attractiveness, thus eliminating the possibility that attractiveness might explain any observed variations in packaging perception and disposal behaviour (Mugge & Schoormans, 2012).

Then they are requested to read the information provided on the paper positioned on the table thoroughly.

Emotional responses: Participants' emotional responses were measured utilizing the PrEmo instrument (Desmet, 2003), which employs vivid cartoon characters to represent specific emotions. It is a validated tool that gauges emotional responses to products. Participants were presented with the question, "*Please select which emotions you feel (all that apply to you) while experiencing this biscuit packaging (considering the prototype and the final packaging).*" The spectrum of emotions included 14 distinct feelings provided in the instrument kit, with

7 positive emotions (pride, attraction, fascination, hope, desire, admiration and joy), as well as 7 negative emotions (sadness, fear, contempt, scepticism, shame, aversion and boredom).

Thoughts and feelings derived from the packaging experience: Participants were invited to explore the reasons behind the selected emotions in the previous question and share some other thoughts and feelings arising from their packaging experience. It was measured through a thought listing task (Edell & Keller, 1989; Shiv et al., 1997; Shiv & Fedorikhin, 1999), with the open-ended question: "*Please describe here why you feel these emotions and all those impressions, thoughts, and feelings, that you may have while experiencing this packaging. Please describe them in as much detail as possible.*"

Sustainability perception of the packaging: A seven-point scale ranging from 1 (very unsustainable) to 7 (very sustainable) was used to measure sustainability perception, with the question: "*To what extent is this packaging sustainable to you (considering the tray and the information?*" (Granato et al., 2022b).

Connectedness to the origin of the supply chain: This scale was developed drawing from the Connectedness to Nature Scale (CNS) (Mayer & Frantz, 2004). The original scale consists of 14 items, employing a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree) to gauge an individual's feelings (not only emotionally, but also cognitively) of connection and belongingness to nature (Perrin & Benassi, 2009; Mayer & Frantz, 2004). Numerous studies have shown that CNS can effectively predict environmental behaviours (e.g., Martin et al., 2020a; Gosling & Williams, 2010; Mayer et al., 2009). Adapting this concept for the present research, a tailored nine-item scale was constructed to assess the induced psychological distance or connectedness to the origin of the supply chain.

Participants were asked "*To what extent do you agree with the following statements? When I interact with this packaging (reading the information, looking at its design, holding the tray in my hand...)*" (1 = completely agree, 7 = completely disagree). The nine items used were as follows: *(1) I feel a sense of oneness with the packaging raw material. (2) I feel connected with this packaging. (3) I can imagine myself to be part of the overall production process of this product-packaging. (4) I feel close to the origin of this packaging. (5) I feel that all the materials, processes, and me in the supply chain share a common purpose. (6) I feel like I am playing a significant role in this supply chain. (7) I feel distant from the start of this supply chain. (8) I feel that there is a lot of time between me and the raw material. (9) I feel that I am far away in space from the raw material. The last three items were reverse-coded to ensure consistency in scoring.* A reliability test was conducted to assess the internal consistency of the fear of computing subscale, which demonstrated good reliability (unidimensional; $\alpha = .82$). All items appeared to be worthy of retention: the greatest increase in alpha would come from deleting item 9, but removal of this item would increase alpha only by .002. All items correlated with the total scale to a good degree (lower r = .118). Responses to all nine items were averaged to create a single index of connectedness to the origin of the supply chain.

Perceived consumer effectiveness: A seven-point scale ranging from 1 (strongly disagree) to 7 (strongly agree) was adapted from the original two-item scale by Ellen et al. (1991), to make it more applicable to the context of the packaging production process and supply chain. Participants were asked, "*To what extent do you agree with these other 2 statements? When I interact with this packaging (reading the information, looking at its design, holding the tray in my hand...)*" The statements were as follows: (*1) There is not much that any individual can do to contribute to the packaging supply chain. (2) The efforts of one person in maintaining the packaging life cycle are useless as long as other people refuse to participate* (r = 0.37).

Manipulation Check: The effectiveness of the manipulation regarding the packaging visualization and claim was assessed using a single-item 7-point scale (1 = Very few steps, 7 = Very many steps): "*Considering the packaging and the information provided, how many steps do you think are involved in the packaging production process?*"

In the final section of the survey, participants were asked to answer a few more questions measuring their environmental concern, brand attitude, product purchase intention, and demographic information such as age, gender, nationality, city of residence, as well as an open-ended question for a final comment. Environmental concern and demographic factors would be included as potentially relevant control variables in the analysis of consumer responses.

Environmental concern: Participants were then asked to complete a three-item 7-point scale on the environmental concern: "*I normally make a conscious effort to limit my use of products that are made of scarce resources*"; "*I have switched products for ecological reasons*"; "*When I have a choice between two equal products, I always purchase the one that is less harmful to other people and the environment*" (1 = completely agree, 7 = completely disagree) as developed by Cervellon (2012). Responses for all three items were averaged into one scale (unidimensional; $\alpha = 0.76$). Environmental concern, which has been reported to significantly moderate sustainable consumer responses in previous research (e.g., Ischen et al., 2022; Cachero-Martínez, 2020; Magnier & Schoormans, 2015), was included in the analysis as a control variable. To be able to include this variable in the subsequent three-way ANOVA analysis and examine its effect on sustainability perception, responses were subjected to a median split, resulting in two groups: 0 - low (n = 143) and 1 - high (n = 109) in environmental concern (Ischen et al., 2022; Minton & Rose, 1997).

Attitude toward brand: Participants' attitude toward the brand was measured using a self-constructed single-item scale, with the question: "*How do you feel towards the brand?*" (1 = very negative, 7 = very positive).

Purchase intention: Purchase intention of the packaged biscuit was evaluated through a one-item scale: "*Considering the overall product-packaging, how likely are you to purchase it?*" (1 = very unlikely, 7 = very likely) (Dodds et al., 1991).

Gender: Gender was measured by asking participants to select their gender from a list of options, including Male, Female, and Other. The question was phrased as "*Please select the gender which you identify yourself with*".

Age: Participants were asked to enter their age in a text box: "*Please digit here your age*". Upon examining the age distribution of the participants, the age variable was re-coded into a categorical variable with two groups based on its median: 0 - younger adults (age range: 17-22) and 1 - older adults (age range: 23-44). This recording was undertaken to facilitate the subsequent analysis on sustainability perception.

Nationality: Participants were asked to fill in their nationality in a text box: "*Please state your nationality*".

City of residence: Participants were asked to state their nationality in a text box: "*Please state your town/city of residence*". This information was used as a proxy to capture variations in waste categorization and separation practices across different cities. The indirect nature of this question was adopted to avoid potential bias or suspicion about the research objectives that could arise from asking directly about waste practices. The responses were subsequently coded as either 0 for "other cities" or 1 for "Delft" to reflect the distinct waste disposal policies between cities.

Comment: Participants were asked to leave some last comment with an open-ended question: "*If you have a comment on the research, you can leave it here*".

Disposal behaviour: Participants were instructed on how to dispose of the packaging after completing the questionnaire. The following message was provided: "*To help us keep the lab tidy and get it ready for the next participant, we kindly ask you to empty your table and throw away any waste on your way out. Thank you for your cooperation!*" The analysis method to measure disposal behaviour would be elaborated in the analysis plan.

These measurements and their descriptive statistics are summarized in Table B.1, Appendix B.

3.5. Analysis plan

Manipulation and confounding Check: To evaluate the effectiveness of the packaging visualization and claim manipulation in influencing the perceived length of the supply chain, an independent sample t-test was conducted. In addition, to examine any potential confounding effect, an independent t-test was conducted to assess the impact of the implicit cues on tray appeal.

Thought Listing Task: The answers to the thought listing task were analysed through coding and frequency analysis by counting the number of thoughts. The text was coded using a predefined code book that comprised the following codes: "sustainability", "sustainability negative", "good packaging quality positive", "bad packaging quality", "good product quality", "bad produce quality", "convenience", "novelty", "scepticism", "lack of visuals", "information overload", "appealing", and "unappealing". In cases where respondents mentioned more than one thought related to the same code, only one count was made. Among the predefined codes, several notable

categories consistently emerged as prominently mentioned: “sustainability”, “good packaging quality”, “novelty”, “scepticism”, “lack of visuals”, and “information overload” (details in Table C.1, appendix C). Frequencies of each code (0 - not elicited, 1 - elicited) were calculated and compared across conditions using Crosstabs Chi-square test and z-test with Bonferroni-adjusted p-values (Granato et al., 2022b).

Sustainability perception: An ANOVA was conducted to test the main effect of implicit and explicit cues on perception of sustainability, and also the interaction effect. If a significant interaction effect was found, a subsequent pairwise analysis would be conducted.

Mediation analysis - connectedness to the origin of the supply chain: To test the mediation effect of connectedness to the origin of the chain, moderated mediation analysis was conducted using Hayes' PROCESS macro (Model 7) (Hayes, 2012) in SPSS. The independent variable was packaging design strategy, the dependent variable was perceived sustainability, the mediator was connectedness to the origin of the chain, and the moderator was connectedness to the origin of the chain. A similar analysis will be performed with the dependent variable being disposal behaviour.

Disposal behaviour: Disposal behaviour of the packaging was analysed by examining the waste bins. The participants' disposal behaviour was categorized as sustainable (coded as 1) if they disposed of the packaging into the organic bin. If they threw away the packaging in a different bin (either plastic, general or paper), their behaviour was coded as unsustainable (coded as 0). Data were analysed with frequency analysis and binary logistic regressions to test the effects of implicit and explicit cues, controlled for environmental concern (Granato et al., 2022b). Additionally, environmental concern and other demographic variables such as gender, age, city of residence were also included as covariates to control for the possible effect on the disposal behaviour.

Mediation analysis - perceived consumer effectiveness: To examine the mediation effect of psychological distance, Hayes' PROCESS macro (Model 7) (Hayes, 2012) in SPSS was utilized. The independent variable was packaging design strategy, the dependent variable was perceived sustainability, and the mediator was perceived consumer effectiveness.

Biscuit evaluations: A series of two-way ANOVAs was also carried out to investigate the effects of packaging design strategy and packaging visualization and claims on the biscuit and packaging evaluations. This will allow us to determine whether participants' evaluations of the biscuits and packaging differ based on the implicit and explicit cues of the packaging.

Emotional responses: First, the data was prepared by coding each selected emotion as a separate binary variable (0 - not selected, 1- selected). Descriptive analysis can then be performed to calculate the frequencies of each emotion, providing an overview of the distribution of emotional responses among participants. Comparative analysis was then conducted using Crosstabs to compare the frequencies of emotions across different conditions or groups, with Chi-square tests used to assess significant differences. Additionally, cumulative scales were constructed for positive and negative emotions by summing all the emotions within each category, allowing the exploration of the potential impact of packaging cues on emotional responses and the potential mediating role of emotions in sustainable disposal behaviour.

4. Results

4.1. Manipulation and confounding checks

A manipulation check was conducted to assess the effectiveness of the supply chain length manipulation. An independent-samples t-test was conducted, demonstrating a significant difference in the perceived number of steps involved in the packaging production process between the two conditions, with participants in the long supply chain condition perceiving a greater number of steps (M_{long} = 5.65, M_{short} = 5.30, t(248) = 2.09, $p < 0.05$). This suggests successful manipulation of supply chain length through the variations in packaging visualization and claim. The long supply chain (6 steps) was perceived as longer than the short supply chain (3 steps).

An independent t-test was performed to explore the potential confounding effect of tray appeal on sustainability perception and disposal behaviour. However, the results indicated no significant differences in the appeal of the tray between the design strategy conditions ($M_{imitation}$ = 3.43, $M_{differentiation}$ = 3.70, t(248) = -1.46, p = .20). These findings suggest that variations in tray appeal did not provide an alternative explanation for any observed differences in the dependent variables.

4.2. Effect of explicit and implicit cues on sustainability perception of the packaging (H1a, H2a, H3)

In order to test hypothesis H1a, H2a, and H3a, H3b about the effect of implicit (packaging design strategy: differentiation vs. imitation) and explicit cues (packaging visualization and claims: long vs. short supply chain), and their interaction on the packaging's sustainability perception, a two-by-two ANOVA was performed. Environmental concern was first entered in the analysis as a covariate but was not significant ($p = .16$) and was therefore removed from the analysis. Results demonstrated a significant main effect of design strategy ($F(1, 248) = 6.51$, $p = .01$, part. $\eta^2 = .03$), indicating that participants perceived the packaging following the differentiation strategy ($M = 5.21$, $SD = .11$) as more sustainable than those following the imitation strategy ($M = 4.80$, $SD = .11$) (Fig. 7(a) and (b)). **Consequently, H1a was supported.** However, there was no significant main effect of the length of the supply chain ($F(1, 248) = 0.42$, $p = .52$, part. $\eta^2 = .001$) or the interaction between the implicit and explicit packaging cues ($F(1, 248) = 0.05$, $p = .83$, part. $\eta^2 = .00$) on sustainability perception. **H2a and H3 were therefore not supported.**

Given the lack of significant effects from the explicit cues and their interaction with packaging cues on sustainability perception, demographic factors such as gender, age (0 - younger adults, and 1 - older adults), along with environmental concern (0 - low, 1 - high) were incorporated as independent variables in a three-way ANOVA to explore other potential influences on sustainability perception. Notably, when 'gender' was added, a significant two-way interaction effect between the length of the supply chain and gender on sustainability perception emerged ($F(1, 242) = 4.52$, $p = .03$, $\eta^2 = .02$) (See Fig. X, Appendix C). Specifically, male participants perceived the packaging in the long supply chain condition ($M = 5.24$, $SD = 1.13$) as more sustainable than the one in the short supply chain condition ($M = 4.80$, $SD = 1.29$). Contrastingly, female participants perceived the packaging in the short supply chain condition ($M = 5.06$, $SD = 1.27$) as more sustainable compared to the one in the long supply chain condition ($M = 4.85$, $SD = 1.44$).

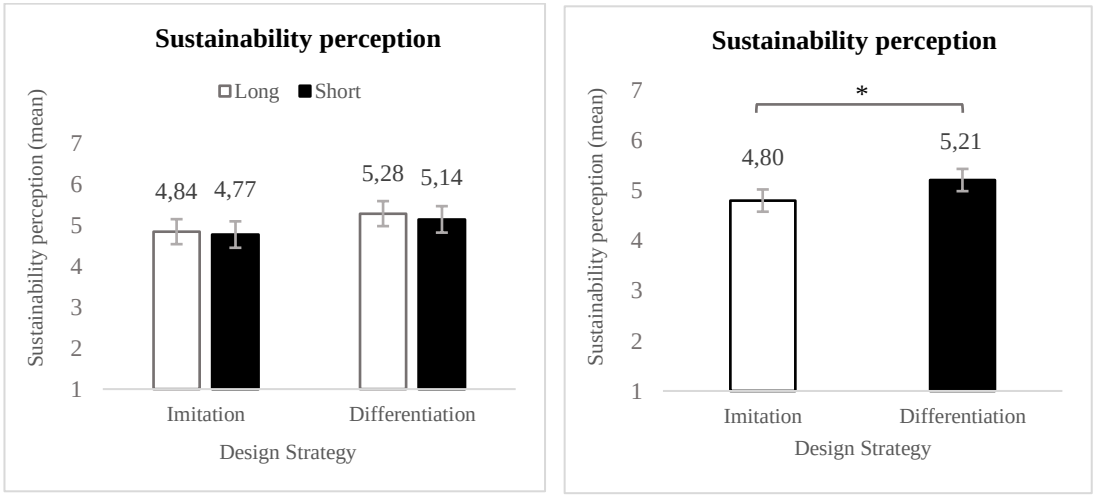


Fig. 7. (a) Sustainability perception of the biscuit packaging. (b) The main effect of design strategy on sustainability perception. Asterisk Brackets above the bars indicate significant differences in sustainability perception (*$p < .05$)

4.3. Effect of explicit and implicit cues on disposal behavior (H1b, H2b, H4)

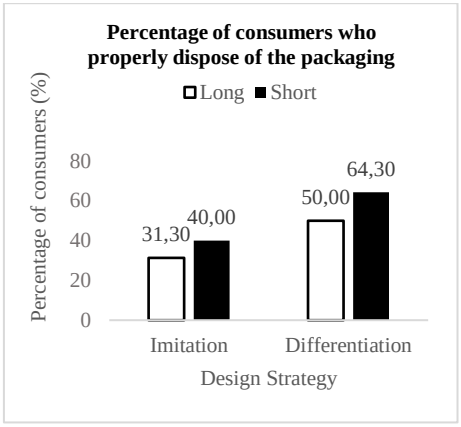
To examine the main and interaction effects of implicit and explicit cues on sustainable disposal behaviour (coded as 0 = unsustainable, 1 = sustainable) and test hypotheses H1b, H2b, H4a, and H4b, a logistic regression analysis was performed.

First, the main effect of implicit and explicit cues on disposal behaviour was examined. The results demonstrated a significant effect of design strategy on disposal behaviour ($\chi2\ (1) = 11.49$, $p < .001$) and a marginally significant effect of supply chain length on disposal behaviour ($\chi2\ (1) = 7.79$, $p = .07$). To control for potential confounding effects, environmental concern and other demographic variables (gender, age, and city of residence) were included as covariates in the analysis (Table 2). After incorporating these controlling variables, the main effects remained largely unchanged. The effect of design strategy on disposal behaviour continued to be

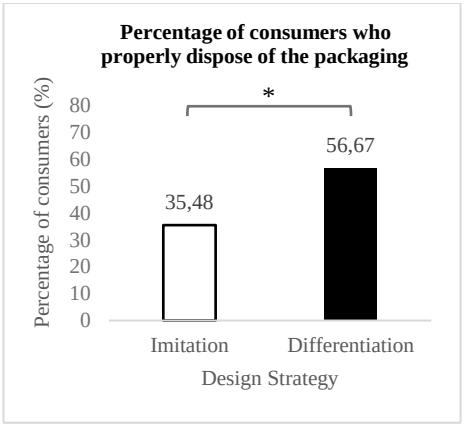
significant ($\chi2$ (1) = 5.34, p < .001), and the effect of the length of the supply chain on disposal behaviour became statistically significant ($\chi2$ (1) = 4.33, p = .04) (Fig. 8(a), (b) and (c)). In the next step, the interaction term between implicit and explicit cues was included in the analysis to investigate the interaction effect. However, while the main effect of the design strategy on disposal behaviour retained its significance ($\chi2$ (1) = 4.60, p = 0.03), neither the length of the supply chain ($\chi2$ (1) = 1.03, p = 0.31) nor the interaction between packaging cues ($\chi2$ (1) = 0.21, p = 0.70) appeared to significantly affect disposal behaviour. Since no interaction was observed, the interaction term was subsequently removed from the final model.

Delving into the specific effects of the predictors, when transiting from packaging adopting an imitation strategy to packaging adopting a differentiation strategy, there was a 0.94 unit of increase in the likelihood of correct disposal behaviour (p < .001). This suggests consumers are more likely to dispose of packaging employing a differentiation strategy correctly than the packaging following an imitation strategy. Moreover, moving from a long supply chain to a short supply chain led to a 0.52 unit of increase in the likelihood of correct disposal behaviour, indicating that consumers dispose of packaging with a short supply chain more sustainably compared to those with a long supply chain (p = .04). Lastly, other variables in the analysis, such as gender, age, city of residence, and environmental concern, were not found to have significant effects on disposal behaviour (See Table 2).

These findings demonstrate the significant effect of both the implicit and explicit cues in shaping sustainable disposal behaviour, **supporting H1b and H2b**. However, there was no significant interaction effect observed between design strategy and the length of the supply chain, which **did not support H4**. The outcome underscores the effectiveness of design strategy as an implicit cue, not only in enhancing sustainability perception but also in promoting actual ecological disposal practices, fortifying the argument for the efficacy of implicit cues in steering consumers towards more sustainable behaviours.



a



b

c

Fig. 8. (a) Sustainable disposal behaviour. (b) The main effect of design strategy on disposal behaviour. (c) The main effect of length of the supply chain on disposal behaviour. Asterisk Brackets above the bars indicate significant differences in sustainability perception (*p < .05)

Table 2
Effect of implicit (design strategy) and explicit (length of the supply chain) cues on disposal behaviour. Effect controlled for gender, age, city of residence, and environmental concern.

	β	S.E.	Wald	df	p
Design strategy (0 - imitation, 1 - differentiation)	.94	.27	12.04	1	<.00
Length of the supply chain (0 - Long, 1 - Short)	.57	.27	4.33	1	.04
Gender (0 - female, 1-male)	-.32	.27	1.40	1	.24
City of residence (0 - other cities, 1 - Delft)	.23	.30	.60	1	.44
Age	-.01	.05	.04	1	.99
Environmental concern	.06	.10	.31	1	.58
Constant	-.94	1.18	.64	1	.42

Note: Design strategy, Length of the supply chain, Gender, and City of residence were coded as "0" (baseline condition) and "1"; Age was in years; and environmental concern was based on scores.

4.4. The mediating role of connectedness to the origin of the supply chain in the relationship between packaging cues and sustainable consumer responses (H5)

To examine Hypotheses H5a and H5b, which posit that the effect of implicit and explicit cues, as well as their interaction, on sustainability perception and disposal behaviour would be mediated by the sense of connectedness to the origin of the supply chain. Moderated mediation regression analyses were conducted utilizing Hayes' PROCESS (Model 7) (Hayes, 2012). Firstly, an analysis was performed to investigate the mediation between the packaging cues and the perception of packaging sustainability (Fig. 9).

The regression model for connectedness to the origin of the supply chain (M) indicated that design strategy had a significant positive effect (b = 0.38, SE = 0.18, t = 2.11, p = 0.04) on the level of connectedness experienced by individuals. However, the length of the supply chain did not have a significant effect (b = -0.01, SE = 0.19, t = -0.04, p = 0.97) on the level of connectedness. Additionally, the interaction effect between the implicit and explicit cues on the connectedness to the origin of the chain was not significant (b = -0.15, SE = 0.26, t = -0.57, p = 0.57).

The regression model for sustainability perception (Y) revealed a marginally significant direct effect of design strategy on sustainability perception (X) (b = 0.29, SE = 0.15, Z = 1.90, p = .06) and a significant effect of connectedness to origin of the supply chain (M) (b = 0.40, SE = 0.07, Z = 5.44, p < .001) on sustainability perception.

In terms of conditional indirect effects, there was a significant effect of design strategy on sustainability perception via the connectedness to the origin of the supply chain in the long supply chain condition (b = 0.15, CI [.01, .31]). This was not the case in the short supply chain condition (β = 0.09, CI [-.06, .25]). The moderation of the mediation effect by the supply chain length, as indicated by the index of moderated mediation, was not significant (β = -.06, CI [-.28, .15]).

In conclusion, design strategy was found to significantly influence connectedness to origin of the supply chain, which subsequently had a significant effect on sustainability perception. Participants perceived packaging using a differentiation strategy as more sustainable than that employing an imitation strategy, as it fostered a greater connection with the packaging source and the start of the supply chain. While the direct effect of design strategy on sustainability perception was noted, it did not reach statistical significance, indicating that the relationship between design strategy and sustainability perception is partially mediated by the connectedness to the origin of

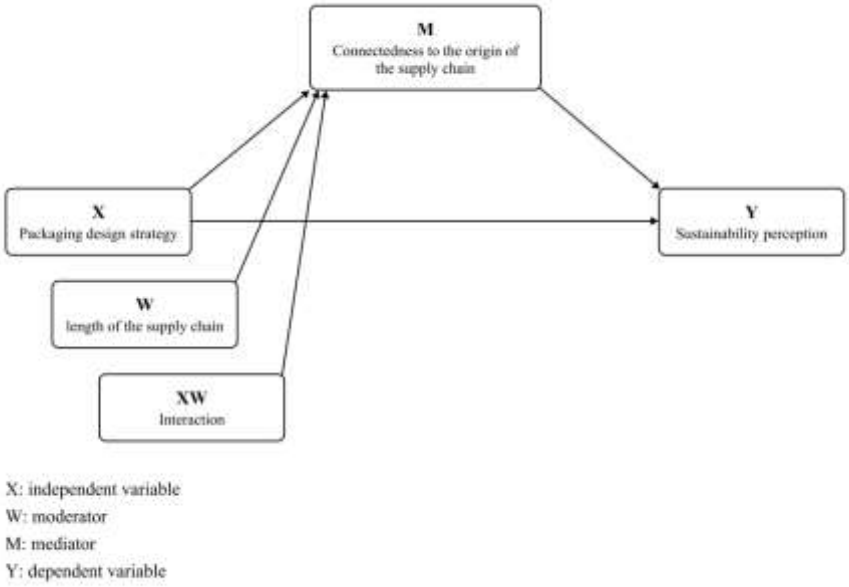


Fig. 9. Statistical moderated mediation regression model (using PROCESS Model 7)

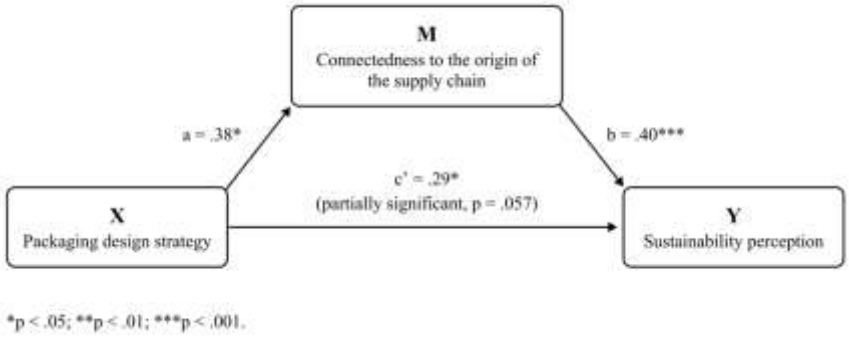


Fig. 10. Reported mediation effect of connectedness to the origin of the supply chain between design strategy and sustainability perception.

the supply chain. However, the mediation role of connectedness did not significantly vary across levels of supply chain length. As a result, **H5a was partly supported**, suggesting that only the effect of implicit cues on sustainability perception is mediated by an increased level of connectedness to the origin of the chain (Fig. 10).

Additionally, the potential mediating effect of connectedness to the origin of the supply chain on the relationship between implicit and explicit cues and disposal behaviour was examined (Fig. C.2, Appendix C). The analysis revealed a significant effect of design strategy on connectedness to the origin of the chain (b = 0.40, SE = 0.18, t = 2.20, p = 0.03). However, no significant effects were found for the length of the supply chain (b = -0.03, SE = 0.19, t = -0.15, p = 0.88) or the interaction between design strategy and length of supply chain (b = -0.20, SE = 0.26, t = -0.76, p = 0.45) on the level of connectedness. Furthermore, the connectedness to the origin of the supply chain did not significantly predict disposal behaviour (b = 0.01, SE = 0.13, Z = 0.11, p = 0.91). These findings indicate that design strategy significantly influenced disposal behaviour, but connectedness to the origin of the chain was not identified as the mediating factor, leading to the **rejection of H5b.**

4.5. The mediating role of perceived consumer effectiveness in the relationship between packaging cues and disposal behaviour (H6)

To examine hypothesis H6, which investigates the mediating role of perceived consumer effectiveness (PCE) in the relationship between packaging design strategy, psychological distance, and sustainable disposal behaviour, a moderated mediation analysis was conducted using Hayes' PROCESS macro (Model 7) in SPSS (figure C.3, Appendix C).

The results showed that design strategy did not have a significant effect on perceived consumer effectiveness ($b = -0.24$, $SE = 0.26$, $t = -0.94$, $p = 0.35$), and neither did the length of the supply chain ($b = 0.01$, $SE = 0.26$, $t = 0.05$, $p = 0.96$). These findings suggested that both the implicit and explicit cues did not significantly predict perceived consumer effectiveness. Furthermore, the interaction term (design strategy x length of the supply chain), did not yield a significant result ($b = -0.17$, $SE = 0.37$, $t = -0.46$, $p = 0.65$), suggesting that the relationship between design strategy and perceived consumer effectiveness was not moderated by length of the supply chain.

In predicting disposal behaviour, the direct effect of design strategy was significant ($b = 0.87$, $SE = 0.26$, $Z = 3.29$, $p < .001$), indicating that design strategy significantly influenced disposal behaviour. The effect of perceived consumer effectiveness on disposal behaviour was not significant ($b = 0.02$, $SE = 0.09$, $Z = 0.17$, $p = 0.87$), implying that perceived consumer effectiveness did not significantly predict disposal behaviour. The indirect effect of design strategy on disposal behaviour through perceived consumer effectiveness was not significant at either level of psychological distance (long: $b = -.00$, CI [-.08, .07]; short: $b = -.01$, CI [-.11, .09]).

Additional analyses were performed to explore the potential mediating roles of other factors, including positive and negative emotions, and sustainability perception, in the relationship between packaging cues and disposal behaviour. However, no evidence of mediation was found in any of these instances.

In summary, these results suggest that perceived consumer effectiveness did not mediate the relationship between design strategy, length of the supply chain, and disposal behaviour. **Therefore, H6 was rejected**. A summary of the hypothesis testing results is presented in Table 3.

Table 3

Summary of hypothesis testing results

Hypothesis	Description of effects	Results
H1a	Effect of implicit cues on sustainability perception (differentiation > imitation)	Supported
H1b	Effect of implicit cues on disposal behaviour (differentiation > imitation)	Supported
H2a	Effect of explicit cues on sustainability perception (short supply chain > long supply chain)	Not supported
H2b	Effect of explicit cues on disposal behaviour (short supply chain > long supply chain)	Supported
H3a, H3b	Interaction effect of implicit and explicit cues on sustainability perception	Not supported
H4a, H4b	Interaction effect of implicit and explicit cues on disposal behaviour	Not supported
H5a	Mediating effect of connectedness to the origin of the supply chain between packaging cues and sustainability perception	Partially supported (between design strategy and sustainability perception)
H5b	Mediating effect of connectedness to the origin of the supply chain between packaging cues and disposal behaviour	Not supported
H6	Mediating effect of perceived consumer effectiveness between packaging cues and disposal behaviour	Not supported

4.6. Additional analysis

4.6.1. Emotional responses

Additional analyses were performed to investigate the potential effects of implicit and explicit cues on other measured variables. Specifically, a descriptive analysis was conducted to examine the emotional responses of participants. Frequencies and percentages were calculated for each emotion, providing an overview of the distribution of emotional responses among the sample. Among the emotions assessed, the most frequently reported emotions were fascination (65.10%), scepticism (43.30%), boredom (33.70%) and admiration (27.40%).

The cumulative amounts of positive and negative emotions were computed, followed by a two-way ANOVA analysis to explore the possible influence of implicit and explicit cues on emotional responses. The result of the two-way ANOVA found no significant impact of design strategy ($F(1, 248) = 0.12$, $p = .74$, $\eta2 = .00$), length of supply chain ($F(1, 248) = 0.20$, $p = .89$, $\eta2 = .00$), or their interaction ($F(1, 248) = 0.11$, $p = .74$, $\eta2 = .00$) on positive emotions. Likewise, there was no significant impact of design strategy ($F(1, 248) = 0.96$, $p = .33$, $\eta2 = .00$), length of supply chain ($F(1, 248) = 0.03$, $p = .87$, $\eta2 = .00$), or their interaction ($F(1, 248) = 0.10$, $p = .75$, $\eta2 = .00$) on negative emotions. These results indicate that neither the explicit cues nor the implicit cues, or the interaction between them, significantly influenced the emotional responses, be they positive or negative.

Chi-square tests and z-tests with Bonferroni-adjusted p-values were conducted for each emotion (Fig. 11, results of all emotional responses across conditions in Table C.3, Appendix C). These findings suggest that the implicit and explicit cues influence certain emotional responses among participants, specifically desire, hope, and scepticism (Table 4).

Desire: Design strategy (imitation vs. differentiation) showed a significant effect on the emotion of desire (χ^2 (1) = 9.04, $p < .01$). Participants in the differentiation condition reported a higher frequency of desire (n = 22) compared to those in the imitation condition (n = 7, $p < .01$). Similarly, length of the supply chain (long vs. short) also had a significant effect on desire (χ^2 (1) = 11.22, $p < .01$). Participants in the long supply chain condition reported a higher frequency of desire (n = 24) compared to those in the short supply chain condition (n = 5, $p < .01$).

The results obtained in this study demonstrate that packaging designed with a differentiation strategy elicits a more favourable perception of sustainability compared to packaging designed with an imitation strategy. Packaging that emphasizes unique sensory properties and distinctiveness may signal a commitment to sustainability, which can enhance consumers' desire for the packaging. Previous research has also revealed a positive relationship between implicit packaging cues and brand evaluation, indicating that packaging with ecological characteristics can contribute to an increased perception of social responsibility (Magnier & Schoormans, 2017). The heightened perception of social responsibility associated with the differentiation strategy may consequently elevate consumers' level of desire for the product.

Although there is no direct theoretical basis to explain the effect of the supply chain's length on desire, several plausible assumptions could shed light on this phenomenon. Firstly, the addition of more steps in the supply chain may introduce greater complexity to the information presented. This heightened complexity could increase individuals' curiosity as they seek to comprehend the intricate processes and stages involved in the product's creation (Loewenstein, 1994). A longer supply chain may also offer opportunities for more elaborate and engaging storytelling about the product's journey, detailing each step it has undergone. This can foster a higher level of curiosity and engagement, potentially increasing its appeal. Additionally, a longer supply chain might be seen as indicating more effort, care, or quality control in the production process. This could enhance the perceived value of the product, and thus consumer desire.

Hope: The analysis showed no significant effect of design strategy on the emotion of hope (χ^2 (1) = 0.15, $p = .70$). However, the length of the supply chain had a significant effect on hope (χ^2 (1) = 5.21, $p = .02$). Participants in the short supply chain condition reported a higher frequency of hope (n = 33) compared to those in the long supply chain condition (n = 22, $p = .02$).

The heightened sense of hope in the short supply chain condition could be due to its perceived lower environmental impact. The short supply chain might have been perceived as having a smaller environmental footprint, less pollution and lower energy consumption for its considered fewer production steps and shorter distance. It could lead to feelings of hope and optimism regarding the positive impact of the production processes on the environment. However, when forming their overall sustainability perception, participants likely considered a broader range of factors beyond just the environmental impact within the production, potentially explaining the lack of difference in sustainability perception between the conditions.

Scepticism: Design strategy had a significant effect on scepticism (χ^2 (1) = 11.04, p < .01). Participants in the imitation condition reported a higher frequency of scepticism (n = 68) compared to those in the differentiation condition (n = 41, p < .01). There was no significant effect of the length of the supply chain on scepticism (χ^2 (1) = 0.29, p = .59).

This finding is consistent with the previous research (e.g., Granato et al., 2022; Magnier & Crié, 2015; Magnier & Schoormans, 2015; Magnier & Schoormans, 2017), indicating that consumers tend to exhibit greater scepticism toward ecological packaging with conventional plastic properties. This increased scepticism towards the packaging with an imitation strategy could stem from its strong resemblance to conventional transparent plastic packaging. Given the unfamiliarity and lack of knowledge of this eco-friendly packaging, consumers may struggle to reconcile its familiar appearance with its purported environmental benefits. This discrepancy may lead to suspicions about its compostability and a concern that the product might be engaging in "greenwashing". In contrast, the packaging following a differentiation strategy, with its distinctive characteristics signalling sustainability, may be perceived as more credible, resulting in reduced scepticism among consumers.

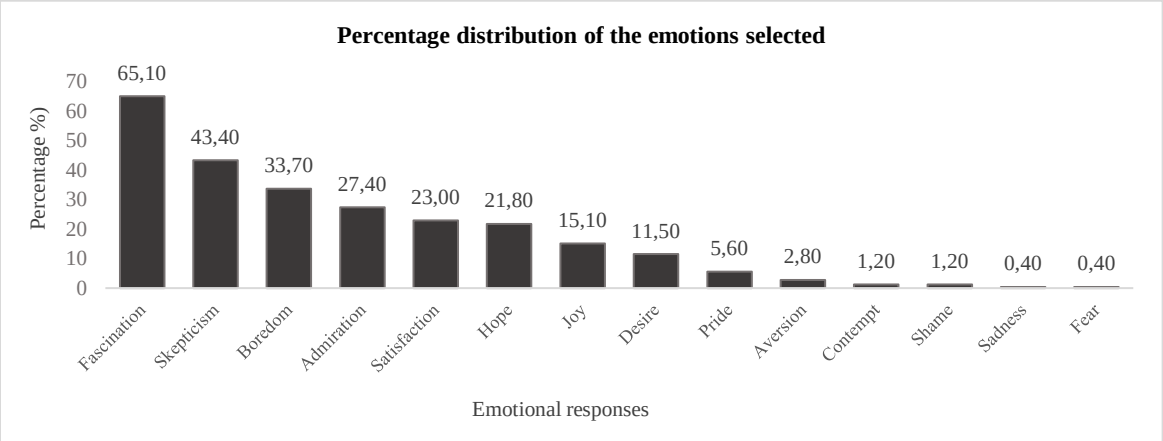


Fig. 11. Percentage distribution of the emotions

Table 4
Frequencies of the emotions (desire, hope, and skepticism)

	Implicit/explicit cues	Long (n = 135)	Short (n = 117)	Total	χ2 (df), p value
Desire	Imitation (N = 127)	4	3	7^a	Implicit $\chi2(1) = 9.04$, $p < .01$
	Differentiation (N = 125)	20	2	22^b	
	Total	24^a	5^b		Explicit $\chi2(1) = 11.22$, $p < .01$
Hope	Imitation (N = 127)	14	15	29^a	Implicit $\chi2(1) = .15$, $p = .70$
	Differentiation (N = 125)	8	18	26^a	
	Total	22^a	33^b		Explicit $\chi2(1) = 5.21$, $p = .02$
Skepticism	Imitation (N = 127)	36	32	68^a	Implicit $\chi2(1) = 11.04$, $p < .01$
	Differentiation (N = 125)	21	20	41^b	
	Total	57^a	52^a		Explicit $\chi2(1) = .13$, $p = .72$

Values sharing the same superscript letter across columns (explicit) or row (implicit) do not differ significantly at the .05 level (Crosstabs with pairwise z-test Bonferronicorrected).

4.6.2. Thoughts elicited

During the process of analysing participants' thoughts and feedback, five main thematic categories emerged: “sustainability”, “good packaging quality”, “novelty”, “scepticism”, “lack of visuals”, and “information overload” (See Extra results of the coding procedure in Table A.4, appendix). Subsequent frequency analysis revealed that

the most recurrent topics were "sustainability" (49.60%), "scepticism" (35.30%), "novelty" (24.20%), and "information overload" (21.80%) (Fig. 12).

Sustainability salience: The relationship between design strategy, length of the supply chain, and the salience of sustainability was examined using a Cross-tabulation Chi-square test and a z-test with Bonferroni-adjusted p-values. The results suggest that design strategy ($\chi^2(1) = 0.57$, $p = 0.45$) and length of the supply chain ($\chi^2(1) = 0.07$, $p = 0.45$), had no significant effect on the mention of sustainability (Table 4). The results indicate that neither implicit nor explicit cues had a significant effect on the salience of sustainability.

Furthermore, similar tests were carried out for the remaining identified categories (Fig. 10, results of all emotional responses across conditions in Table C.3, Appendix C). Remarkably, the Chi-square tests detected a significant association between design strategy and both "Scepticism" and "Information Overload" (Table 5). However, no significant effects of the implicit cues and their interaction were found for the other categories.

Scepticism: Participants were found to be more sceptical towards the packaging when the imitation strategy was used (n = 55), compared to the differentiation strategy (n = 34, p = .01), $\chi^2(1) = 7.15$, $p = .01$ (Table 4). This result aligns with the earlier observations regarding the reported emotion of scepticism.

Information overload: Participants reported higher levels of information overload when the packaging employed the differentiation strategy (n = 38) as opposed to the imitation strategy (n = 20, p = .01), $\chi^2(1) = 7.07$, $p = .01$.

This increased sense of information overload with the differentiation strategy might be attributable to the inherent unique attributes of the packaging that this strategy entails. Differentiation strategy packaging presents consumers with more distinctive features, which in turn demands more cognitive processing than when presented with familiar and conventional packaging following an imitation strategy. Consequently, when combined with additional implicit cues, consumers may experience an overwhelming amount of information to assimilate.

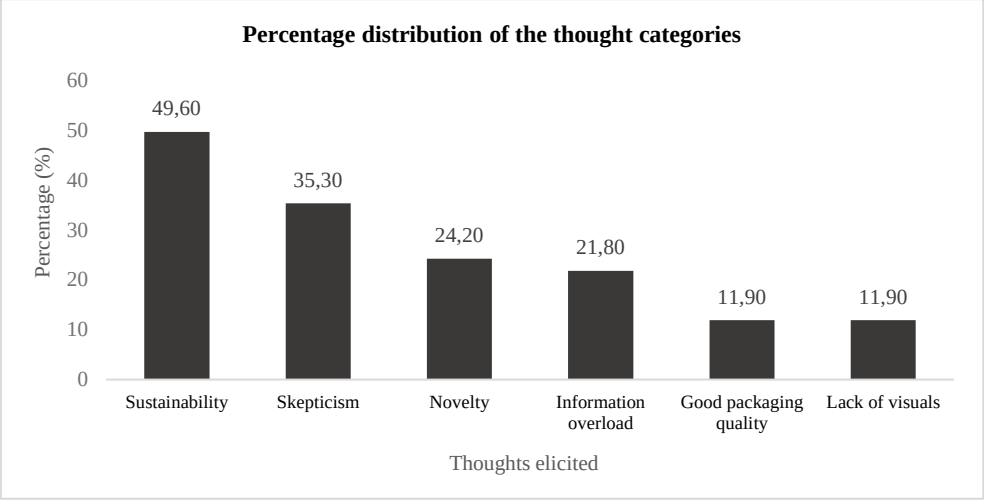


Fig. 12. Percentage distribution of the thought categories

Table 5
Frequencies of the thoughts related to the sustainability of the packaging (coded as "sustainability"), comments on the presence of excessive information on packaging (coded as "information overload") and feelings of skepticism (coded as "skepticism").

	Implicit/explicit cues	Long (n = 135)	Short (n = 117)	Total	χ2 (df), p value
Sustainability	Imitation (N = 127)	38	28	66[a]	Implicit $\chi2(1) = 1.02$, $p = .3$
	Differentiation (N = 125)	30	27	57[a]	Explicit $\chi2(1) = .28$, $p = .59$
	Total	68[a]	55[a]		

Information overload	Imitation (N = 127)	10	10	20[a]	Implicit $\chi2(1) = 7.63$, $p < .01$
	Differentiation (N = 125)	21	17	38[b]	
	Total	31[a]	27[a]		Explicit $\chi2(1) = .00$, $p = .98$
Skepticism	Imitation (N = 127)	29	26	55[a]	Implicit $\chi2(1) = 7.15$, $p < .01$
	Differentiation (N = 125)	18	16	34[b]	
	Total	47[a]	42[a]		Explicit $\chi2(1) = .03$, $p = .86$

Values sharing the same superscript letter across columns (explicit) or row (implicit) do not differ significantly at the .05 level (Crosstabs with pairwise z-test Bonferronicorrected).

6. Discussion

This study aimed to investigate the potential of packaging design elements to communicate packaging sustainability and enhance sustainable disposal behaviour of the packaging. This research examined the impact of an imitation and differentiation strategy on consumer perception and sustainable behaviour, determining which approach more positively influences sustainable actions. The results of our study provide evidence that design strategy plays a crucial role in influencing sustainability perception and sustainable disposal behaviour. Specifically, consumers perceived the packaging following the differentiation strategy as more sustainable compared to the packaging following the imitation strategy. This perception can be partly explained by the partial mediating effect of feeling of connectedness to the origin of the supply chain. The distinct sensory properties showcased in the differentiation strategy (different opacity level compared to transparent plastic) enhanced feelings of connection between the consumer (at the end of the chain) and the origin of the packaging supply chain. Consumers felt more connected and closer to the starting point of the supply chain and the production process of the packaging and these feelings of connection, in turn, made consumers perceive the overall packaging as more sustainable. Additionally, by employing a combination of packaging claims and visualization in our study, this research manipulated the length of the supply chain between the packaging raw material and the final packaging. Our results show that consumers were more likely to dispose of the (compostable) packaging in a proper manner (in the organic bin instead of in any other bins) when exposed to the explicit packaging cues depicting a shorter supply chain, compared to a long one. However, no mediation effect of the connectedness to the origin of the supply chain between the length of the chain and disposal behaviour was found. This suggests, contrary to these research predictions, that the exposure to the shorter chain did not make consumers feel more connected to the origin of the supply chain. Moreover, no significant interaction effects between implicit and explicit cues on sustainable responses were discovered.

6.1. Theoretical implications

The findings of this research contribute to research in environmental psychology, innovation and packaging design by exploring the explicit and implicit communication and its effect on sustainable responses. By extending the focus of most existing research, which primarily concentrates on perceptions and purchase intention, this study focuses into the post-consumption stage of packaging, demonstrating which types of implicit and explicit packaging design cues can effectively increase not only sustainability perception but also disposal behaviour.

First, this research contributes to the studies on the role of packaging design strategies in influencing sustainability perception and disposal behaviour. The result of this research has replicated the findings in Granato et al. (2022) study on how meaningful implicit packaging cues (opacity, colour, look, etc), can contribute to increased perceived packaging sustainability. Consistent with their study and other previous research (e.g., Krah et al., 2019; Magnier & Schoormans, 2017; Magnier & Schoormans, 2015), this research also found that a differentiation strategy, compared to an imitation strategy, can significantly enhance sustainability perception. The distinctive sensory attributes of ecological packaging, highlighted through the differentiation strategy, serve inherently as meaningful reminders for sustainability. Beyond this, this research investigated the role of packaging design strategy on disposal behaviour, which was missing in the research of Granato et al. (2022), where, due to the experimental design, no differences could be observed between different implicit cues. Our findings reveal that packaging designs following a differentiation strategy significantly improve sustainable disposal behaviour

compared to those adopting an imitation strategy. By doing that, this research provides important contributions to the existing literature, which overlooked the effect of distinctive properties of eco-friendly packaging on consumer acceptance (Polyportis et al., 2022; Karana et al., 2018; Magnier et al., 2019). This theoretical contribution builds upon prior research exploring the influence of implicit design elements on driving sustainable packaging disposal behaviour, as demonstrated in studies such as Geiger (2020). Our findings provide additional support for the effectiveness of utilizing implicit packaging cues, specifically adopting a differentiation packaging design strategy, to promote sustainable perception and behaviour, adding to the existing body of knowledge in this area.

In addition, this finding contributes to the theoretical understanding of scepticism as another possible reason explaining why differentiation design strategy has a greater impact on sustainable consumer responses compared to the imitation strategy. An additional analysis of emotional responses and elicited thoughts revealed a significant effect of design strategy on scepticism, with consumers exposed to the imitation strategy expressing greater scepticism towards the packaging than those in the differentiation strategy condition. This finding aligns with the results reported by Magnier and Schoormans (2015), who found that consumers, particularly those with low environmental concern, tend to evaluate conventional-looking packages with verbal sustainability claims more negatively. This negative evaluation stems from the incongruence between the visual appearance of the package and the claimed sustainability, leading consumers to perceive it as a form of greenwashing. As expressed in the qualitative answers, some remarked that they could not imagine that a packaging with a conventional appearance could be compostable and biodegradable in the first place, resulting in uncertainty about the appropriate disposal method. This finding is in line with Taufik et al. (2020), who noted that the combination of plastic packaging being bio-based and compostable appears to evoke relatively strong ambivalence among consumers regarding what to do in terms of waste disposal. Therefore, the scepticism towards the imitation strategy may account for the lower packaging sustainability perception and less correct disposal behaviour.

Second, this research contributes to the study of connectedness to nature by extending and employing the concept of nature connectedness to sustainable packaging communication. Nature connectedness, as an important construct in sustainability research, refers to individuals' closeness and relatedness with the natural environment (Mayer & Frantz, 2004; Mayer et al, 2009). Nature connectedness has been found to positively affect pro-environmental attitudes and behaviour (e.g., Dong et al., 2020; Hernández et al., 2020; Redondo et al., 2021). Building upon the concept of nature connectedness and extending it, this study focuses on connectedness to the origin of the packaging supply chain, making it more targeted and relevant to specific packaging materials. By formulating packaging cues that evoke a sense of closeness and connection with the raw packaging material and the beginning of the production process, sustainability perception was expected to increase. The research outcomes reveal the partial mediating role of connectedness to the packaging source, which provides a fresh lens through which to understand the influence of implicit packaging cues on consumer sustainability perception. The results suggest that specific packaging design interventions—such as differentiation design strategy that underscores the unique nature of the packaging material—could foster a feeling of connectedness to the origin of the chain, thereby amplifying perception of sustainability. However, the mediating effect of connectedness to the origin of the chain was not found between implicit packaging cues and sustainable packaging disposal. One possibility is that the implicit cues directly influence individuals, leading them to engage in more sustainable disposal behaviour without the need for a specific mediating factor. This suggests that the implicit packaging elements themselves may serve as powerful prompts or reminders that trigger desired behaviour in a direct way, without affecting any psychological process in between.

Third, this research contributes to the study on the role of design for sustainable behavioural change by exploring the effect of explicit cues on consumer disposal behaviour of the packaging. Specifically, this is the first research in the domain of sustainable packaging design utilizing the concept of the length of the supply chain to construct on-packaging communication for sustainable behavioural change. The findings suggest that consumers exhibited more correct disposal behaviour when exposed to a short supply chain than when exposed to a long one. However, no significant effect of the length of the chain on sustainability perception was observed. Additionally, contrary to our predictions, perceived consumer effectiveness was not found to be the mediating factor between the length of the chain and disposal behaviour. Additionally, contrary to our predictions, perceived consumer effectiveness was not found to be the mediating factor between the length of the chain and disposal behaviour. This may indicate that the length of the supply chain displayed on packaging did not influence how much consumers felt that they could make a difference by disposing of the packaging correctly. In addition, also the

feelings of connection to the origin of the chain did not mediate between the explicit cues and disposal behaviour. Despite the potential mediators not being validated by the results, connectedness to the origin of the supply chain might still mediate the effect of explicit cues on disposal behaviour. This could possibly stem from our measure for connectedness to the origin of the supply chain, which might not have accurately captured consumers' actual levels of connectedness, leading to non-significant correlations with disposal outcomes. In the literature on nature connectedness, connection with nature can be examined both explicitly and implicitly (e.g., Greenwald, McGhee, & Schwartz, 1998). Explicit and implicit measures involve different psychological processes in behaviour determination (Geng et al., 2015). Generally, implicit measures, to a greater degree, examine automatic processes (Friese et al., 2008; Conrey et al., 2005; Greenwald & Banaji, 1995), while explicit measurements largely employ controllable processes that can override automatic processes. Automatic processes are fast, unintentional, involuntary, effortless, and based on an associative network. In contrast, controlled processes are slower, more intentional, under control, effortful, and require heavier cognitive load and higher-order psychological processing (Friese et al., 2008; Evans, 2008). In the research of Geng et al. (2015), they explored the relationship between explicit and implicit connections with nature and the environmental behaviours, employing a Connectedness to Nature Scale (CNS) to measure explicit CN and an Implicit Association Test (IAT) to gauge implicit CN respectively. The results indicate that explicit connectedness was positively correlated with deliberate environmental behaviours (self-reported environmental behaviours), while implicit connectedness was positively correlated with spontaneous environmental behaviours (situational simulation experiment: usage of plastic bags). Deliberate behaviours are mainly self-report testing proxies of behaviour, such as behavioural intentions and judgments, whereas measures of spontaneous behaviours are mainly experimental methods. Reflecting on the current research, in order to examine consumer's disposal behaviour, which could be considered as a spontaneous behaviour, a corresponding implicit measurement of connectedness to the origin of the chain should be employed. In this regard, the adapted version of the Connectedness to Nature Scale (CNS), used in this research, that measure the construct in an explicit, self-reported way, may not be the most suitable measurement for capturing the specific relationship between connectedness to the origin of the chain and a spontaneous, automatic disposal behaviour. This could potentially explain why the explicit cues in our study did not affect disposal behaviour through feelings of connection to the origin of the chain (as measured in our study). Other underlying mechanisms that can explain the relationship between the explicit cues and disposal behaviour need to be further explored.

Moreover, while the results of this research showed that explicit cues significantly affect disposal behaviour, they do not show any significant effect on sustainability perception of the packaging. This may be explained by the fact that the explicit cues may not provide sufficient information to influence individuals' overall perception of sustainability. In fact, sustainability perception involves a broader evaluation of the overall sustainability of the packaging, which encompasses various factors such as energy consumption and true environmental impact of the production processes, carbon footprint of the entire supply chain, and efficiency of the composting method. It can be reflected through the gathered comments and feedback from the research participants. Participants took into consideration multiple factors when assessing the packaging and expressed concern and scepticism about its actual environmental benefits. Furthermore, it is noteworthy that the perception of packaging sustainability remains relatively high irrespective of the length of the supply chain ($M_{long} = 5.09$, $M_{short} = 4.94$), implying that consumers may perceive both packaging that provide explicit information (both in the long and in the short condition) as equally sustainable. To find a significant difference, it may be relevant to add a control condition where no explicit information is provided.

In sum, this research results show that explicit cues in the form of supply chain length directly shape sustainable disposal behaviour without altering the associated sustainability perception. This might also be indicative of an unconscious, automatic, intuitive process where the explicit cues nudge certain behavioural tendencies without engaging the underlying psychological mechanisms of perception. It suggests that the specific cues presented by the length of the supply chain may unconsciously activate associated mental constructs, thereby guiding disposal behaviour in a direct way (Bargh, 2006; Bargh, Chen, & Burrows, 1996). This could occur without the individual consciously recognizing the impact that these cues exert on their behaviour. This finding underscores the potential for contextual cues to influence behaviour through a nudging approach (Vandenbroele et al., 2019; Bornemann & Burger, 2019; Lehner et al., 2016), even in the absence of conscious perception. This finding challenges traditional assumptions about sustainability communication, which primarily emphasize the

need to change perceptions and attitudes in order to influence behaviour. Instead, the results of this study suggest that focusing on the behavioural aspect directly may be a more effective approach.

Intriguingly, it is also important to note that the impact of the explicit cues on disposal behaviour persists even when they are not present at the moment of disposal (this explicit information was left on the experimental desk by respondents and they were not visible on the packaging at the moment of disposal). This observation suggests that these reminders have the remarkable ability to leave a lasting impression in consumer memory. They continue to exert an enduring influence on individuals' decision-making regarding sustainable disposal, even in the absence of direct exposure to the cues. This finding contributes to the field of sustainability research by shedding light on the lasting effects of explicit packaging reminders and the potential for sustained behaviour change.

Last, the study findings revealed a significant interaction effect between the explicit cues and gender, with males perceiving packaging depicting a long supply chain as more sustainable while females perceiving the opposite (the packaging with a short supply chain) as more sustainable. According to the theory about the different gender responses in information processing (Meyers-Levy & Maheswaran, 1991; Meyers-Levy & Sternthal, 1991), males tend to process informational advertisements in a heuristic manner, relying on simple decision-making rules or cues to form their judgments. On the other hand, females may engage in a more detailed and elaborate processing of advertising information. The research findings by Papyrina (2018) showed that while males feel more persuaded by a greater quantity of arguments in a message, it is not the case for female respondents. It shows that unlike females, males form their judgments based on the mere number of product assertions presented in a message. In the context of sustainability perception, this may translate into males placing greater importance on the number of steps and arrows in the production process presented in the packaging design, which signifies credibility and environmental commitment. As a result, males may perceive the packaging depicting many steps and a long supply chain as more sustainable due to the abundance and great quantity of information indicating environmental efforts. In contrast, females are more prone to process the packaging information in scrutiny and examine the details. Through a more comprehensive understanding of the journey of the packaging, they may develop a stronger connection with the raw material and its life cycle, thus increasing the perceived packaging sustainability. This assumption is supported by the result of the current study, that gender has a significant effect on connectedness to the origin of the chain ($F(1, 248) = 3.92$, $p = .02$, $\eta^2 = .03$) , with females ($M = 3.65$, $SD = 1.01$) showing a higher level of connectedness chain than male participants ($M = 3.28$, $SD = 1.06$). This finding adds to the growing body of literature on gender differences in information processing and their implications for sustainability perception, highlighting the importance of considering gender as a relevant factor in understanding consumer responses to sustainability cues in packaging design.

6.2. Practical implications

This research presents practical insights for marketers, designers, and policymakers on strategically utilizing implicit and explicit packaging cues to effectively convey packaging sustainability to consumers and drive sustainable disposal behaviour.

The findings of this study are particularly relevant in the context of the European Green Deal and the new circular economy action plan, which aim to ensure that all packaging is reusable or recyclable by 2030 (Salini & Burkhardt, 2023). The results provide valuable guidance and suggestions for packaging design strategies that can enhance sustainability perception and disposal behaviour for ecological packaging, such as compostable and recyclable packaging. The study demonstrates that consumers perceive packaging following the differentiation strategy as more sustainable and exhibit proper disposal behaviour. By revealing distinctive sensory properties of the sustainable packaging, such as unique tactile elements and opacity of the material, the packaging can distinguish itself and attract consumer attention, functioning as a good reminder for novelty and sustainability. Notably, there were no significant differences in the quality evaluation of the product (e.g., perceived freshness) or total positive and negative emotions evoked between the two design strategies, countering worries of companies about possible negative responses towards differentiating packaging. Plus, consumers reported more sceptical feelings associated with the packaging following an imitation strategy that does not differentiate and distinguish from conventional plastic looking. In conclusion, companies and designers can adopt the differentiation strategy by displaying its distinctive features, instead of making them invisible. By enhancing the perceived sustainability of their packaging, companies can demonstrate their commitment to addressing packaging issues and remain competitive in the market (e.g., Magnier & Crié, 2015), and potentially lead to higher purchase intention (e.g.,

Kim & Oh, 2020; Magnier & Schoormans, 2017). Government agencies and research labs can introduce new types of standardized packaging to replace the conventional plastic packaging following the differentiation strategy, facilitating correct consumer disposal behaviour.

Furthermore, by employing explicit packaging cues that visually depict a short supply chain with only a few steps in the whole production processes, companies can effectively encourage consumers to make environmentally responsible disposal choices. Visual packaging elements such as simplified illustrations and diagrams, paired with verbal elements like claims and explanations, can be utilized to illustrate the journey of the packaging from raw materials to the final product-packaging. This clear and informative on-packaging information not only communicates the company's sustainability efforts but also serves as a valuable platform to educate consumers about new packaging technologies and novel sustainable materials. Additionally, the research finding demonstrates that the length of the supply chain has a long-lasting effect on promoting disposal behaviour, even in the absence of direct exposure to packaging cues. By leveraging the power of memory and the potential for delayed influence, marketers, designers, and policymakers can employ strategic communication tactics that create strong and enduring associations between sustainable disposal behaviour and the packaging cues that symbolize them. To maximize the impact of such strategies, marketers and policymakers could also consider incorporating this strategy into their advertising and public communication campaigns across various channels. By disseminating information about the short supply chain between consumers and the origin of sustainable packaging, they can increase consumer exposure and awareness. This approach has the potential to foster widespread adoption of sustainable disposal practices and contribute to the broader objective of creating a more sustainable future.

6.3. Limitations and further research

The current research presents some limitations that should be acknowledged. One limitation of this study relates with the participant group, which consisted of mainly University design students. While this sample provided valuable insights into the effects of implicit and explicit cues on sustainability perception and disposal behaviour, it is important to consider that design students may have a heightened focus on the visual aspects of packaging design. This intense focus on design elements may shift their focus from more detailed processing of the packaging information, thus influencing the formation of connectedness to the packaging source. Future research should aim to replicate these findings with a more diverse participant pool that includes individuals from different academic backgrounds and professions. This would help to validate generalizability of the findings and contribute to a more comprehensive understanding of the observed effects. Furthermore, considering participants with varying levels of environmental awareness or prior knowledge about sustainable practices could help identify potential moderating factors that influence the effectiveness of implicit and explicit cues on sustainable responses.

Second, during the experiment, the packaging design was not physically attached to the packaging itself but instead displayed separately in the questionnaire (overall packaging design) and on the table (packaging information). This separation may have hindered participants' ability to fully connect and integrate the implicit and explicit cues, thus limiting their holistic evaluation of the packaging and potentially explain the lack of interaction effect between implicit and explicit cues Research has shown that when design elements are spatially partitioned, consumers experience split attention and cognitive load, leading to reduced cognitive fluency (Schroeder & Cenkci, 2018; Wang et al., 2022). Future research could address this limitation by incorporating a more immersive and realistic experimental setup. For example, utilizing actual packaging prototypes or mock-ups that integrate both the implicit and explicit cues would provide participants with a more realistic and unified experience. This approach allows participants to interact with the packaging and assess its packaging cues more effectively, simulating real-world scenarios. By integrating the cues together, it would provide a more comprehensive representation of how implicit packaging properties and explicit messaging interact to shape consumer sustainable responses.

Third, the current study investigated the effect of the length of the supply chain (long vs. short) with no control condition. Future studies may include a control condition where no explicit packaging cues are provided, to establish a baseline condition for comparison. This would enable a more comprehensive assessment of whether the short supply chain condition enhances the effectiveness of packaging messages in stimulating sustainable consumer responses compared to the baseline condition, as well as whether the long supply chain condition diminishes the effectiveness of a packaging message compared to the baseline condition.

Fourth, participants may experience "information overload" when exposed to excessive and lengthy information displayed on the packaging. Some participants reported feeling overwhelmed by the amount of information presented, which could have impacted their processing and interpretation of the explicit cues. According to the Cognitive Load Theory (Sweller, 1988), our working memory has a limited capacity for processing new information, when the amount of information exceeds this capacity, cognitive overload occurs, leading to decreased comprehension and learning. In the field of packaging communication, Orth & Malkewitz (2008) demonstrated that an overly complex package with abundant information makes it difficult for consumers to process, leading to lower product evaluations. Similarly, studies by van Birgelen, Semeijn, and Keicher (2009) and D'Souza, Taghian, and Khosla (2007) found that an excess of environmental information can breed confusion and scepticism, thereby reducing the effectiveness of sustainability messages. This underlines the need to carefully consider the amount and complexity of information on packaging to ensure it is informative and engaging without overwhelming consumers. Future research can build upon the present study by investigating alternative approaches to presenting explicit cues on packaging that effectively convey explicit cues in a clear, concise, and digestible manner. One potential avenue for future exploration is the incorporation of more visual elements such as icons and images to streamline and simplify packaging information, while also capturing consumers' attention. By experimenting with different designs of explicit packaging cues, future studies can examine whether reducing the amount of information and presenting it in a more visually appealing format enhances the effectiveness of psychological distance in driving sustainability perception and disposal behaviour.

Fifth, as previously discussed, the current measure of connectedness to the origin of the supply chain may not accurately reflect the extent of its impact on disposal behaviour. A promising alternative approach might be the Implicit Association Test (IAT) suggested by Geng et al. (2015b). In the Implicit Association Test (IAT) (Greenwald, McGhee, & Schwartz, 1998), participants use two computer keys to categorize words representing 'me' (I, mine)/'not me' (it, their) and 'nature'/'built.' They simultaneously pair 'me' with either 'nature' (animals, trees) or 'built' (car, city). The relative ease of forming one pair over the other reveals the level of implicit association between 'me' and 'nature.' Future studies could replicate the current study incorporating a refined measurement methodology, to further investigate how a consumer perceived association with the origin of the packaging supply chain influences their disposal behaviours.

Next, given the lack of significant findings related to the influence of the length of the supply chain on sustainability perception, and the lack of support for the proposed mediators between supply chain length and sustainable consumer responses, future exploration of underlying mechanisms that may influence these outcomes is needed. Future research could employ qualitative research methods such as interviews or focus groups to gather participants' in-depth insights and perceptions on the length of the supply chain, allowing for a more nuanced examination of the factors influencing supply chain length and its impact on sustainable responses. Moreover, further studies could help clarify the mechanisms through which supply chain length impacts sustainable behaviour without directly influencing perception, potentially leading to more targeted and effective sustainability communication strategies. In light of our findings that explicit packaging cues have a lasting effect on consumer behavioural change, future research could explore the duration of these reminder effects, investigate the specific cognitive mechanisms at play, and examine the potential for reinforcement or refreshment of these memory traces to enhance sustainable disposal behaviour over time.

Last, an interaction effect was observed between explicit packaging cues and gender on sustainability perception. While the information processing theory may provide a potential explanation, it is important to acknowledge that these interpretations are speculative and require further research to confirm and understand the underlying reasons for these gender differences in response to packaging cues. Future studies could delve deeper into the cognitive processes and decision-making strategies employed by males and females when evaluating sustainability cues in packaging. Additionally, environmental concern was measured in the study and included as a covariate to examine its potential moderating effect on sustainable consumer responses. However, no significant effect of environmental concern was observed on sustainable consumer responses. Future research could explore other personal factors that may influence the relationship between packaging cues and sustainability perception, such as consumers' sustainable packaging related knowledge. This knowledge would be particularly relevant to packaging cues that involve associations with packaging materials and include technical terms and information related to the packaging production process. In summary, future studies can further investigate additional factors that may mediate or moderate the relationship between packaging cues and sustainability perception, such as

gender and sustainability knowledge, could offer a more comprehensive understanding of the underlying mechanisms and facilitate the development of targeted interventions to promote sustainable consumer behaviour.

7. Conclusion

The current study examined the effect of both implicit (packaging design strategy) and explicit packaging cues (packaging visualization and claims that highlights the length of the supply chain) on sustainable consumer responses. The results indicate that packaging design following a differentiation strategy can enhance both packaging sustainability perception and disposal behaviour. Moreover, the depiction of a short supply chain from the raw packaging material to the final packaging via on-packaging messaging seems to stimulate more appropriate disposal practices among consumers. These findings shed light on effective packaging design interventions to facilitate sustainability communication and drive environmentally responsible practices. These insights have practical implications for marketers, designers, and policymakers seeking to enhance sustainability in the packaging industry and contribute to a more environmentally conscious future.

Appendix A. Research stimuli

Table A.1.
Pictures of the biscuits packaging for the study
(front and side of the packaging, and the packaging visualization and claims)

Imitation + long

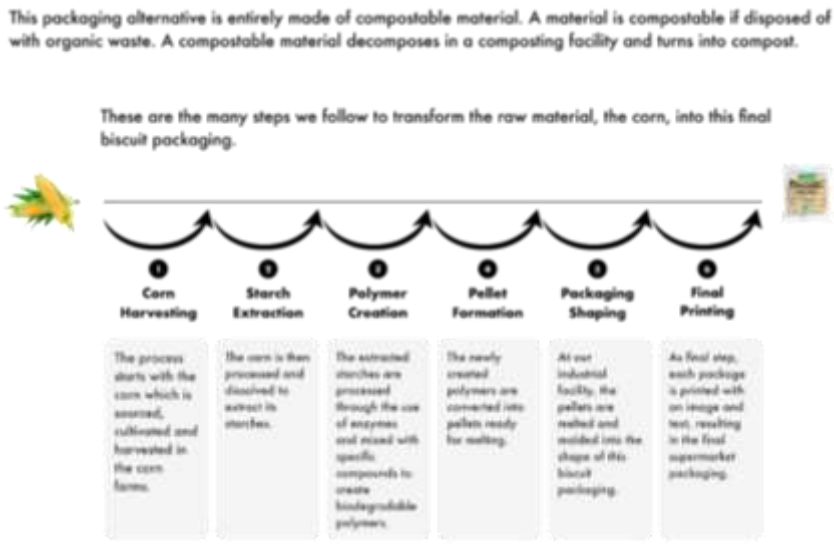
Differentiation + long

Imitation + short


Differentiation + short

Packaging visualization and claims

Long



Short

Appendix B

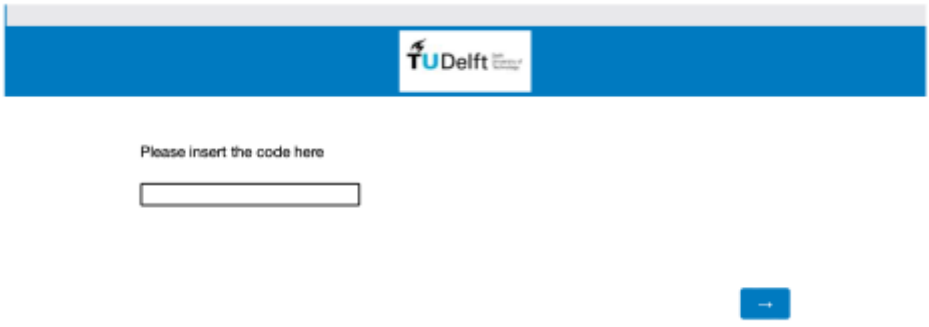
Table B.1.
Measurements and descriptive statistics.

	Imitation		Differentiation	
	Long	Short	Long	Short
Perceived tastiness 1. To what extent do you find the biscuit tasty?	5.55 (1.05)	5.53 (0.93)	5.28 (1.09)	5.51 (1.05)
Perceived naturalness 1. To what extent do you find the biscuit natural?	4.54 (1.35)	4.52 (1.40)	4.72 (1.34)	4.72(1.36)
Perceived freshness 1. To what extent do you find the biscuit fresh?	4.61 (1.30)	4.28 (1.43)	4.25(1.44)	4.47 (1.60)
Product attribute evaluation (open-ended) Do you have any additional thoughts or feedback about the product? (e.g., size, shape, crunchiness, etc). If so, please write them here.				
Tray appeal 1. To what extent do you find the tray appealing?	3.42 (1.44)	3.45 (1.60)	3.96(1.29)	3.39 (1.37)
Emotional responses Please select which emotions you feel (all that apply to you) while experiencing this biscuit packaging (considering the tray and the information).				
Thoughts and feelings derived from the packaging experience Please describe here why you feel these emotions and all impressions, thoughts, and feelings, that you may have while experiencing this packaging. Please describe them in as much detail as possible. You can re-read the information on your desk and experience the tray again if you need.				
Sustainability perception 1. To what extent is this packaging sustainable to you (considering the tray and the information)?	4.94 (1.32)	4.77 (1.31)	5.28 (1.22)	5.14(1.22)
Psychological distance between humans and nature/supply chain (α = 0.82) 1. I feel a sense of oneness with the packaging raw material. 2. I feel connected with this packaging. 3. I can imagine myself to be part of the overall production process of this product-packaging. 4. I feel close to the origin of this packaging. 5. I feel that all the materials, processes, and me in the supply chain share a common purpose. 6. I feel like I am playing a significant role in this supply chain. 7. I feel distant from the start of this supply chain. 8. I feel that there is a lot of time between me and the raw material. 9. I feel that I am far away in space from the raw material.	3.32 (1.14)	3.32 (0.98)	3.70 (0.91)	3.54 (1.13)
Perceived consumer effectiveness (r = 0.37) 1. There is not much that a single individual can do to contribute to this overall product-packaging supply chain.	3.97 (1.44)	3.96 (1.33)	3.65 (1.48)	3.50 (1.56)

2. The efforts of one single person in maintaining this packaging life cycle are useless as long as other people refuse to participate.				
Manipulation check 1. Considering the packaging and the information provided, how many steps do you think are involved in the packaging production process?	5.64 (1.19)	5.20 (1.50)	5.66 (1.25)	5.35 (1.37)
Environmental concern (α = 0.76) 1. I normally make a conscious effort to limit my use of products that are made of scarce resources. 2. I have switched products for ecological reasons. 3. When I have a choice between two equal products, I always purchase the one that is less harmful to other people and the environment.	4.69 (1.26)	4.37 (1.40)	4.38 (1.35)	4.55 (1.24)
Brand attitude 1. How do you feel towards the brand "TreatTaste"?	4.93 (1.06)	4.73 (1.04)	4.66 (0.96)	4.84 (1.07)
Purchase intention 1. Considering the overall product-packaging, how likely are you to purchase it?	4.51 (1.36)	4.23 (1.21)	4.04 (1.35)	4.23 (1.35)
Gender Please select the gender which you identify yourself with. (1 - male, 2 - female, 3 - others)				
Age Please digit here your age (number of years).				
Nationality Please state your nationality.				
Town/city of residence Please state your town/city of residence.				
Final comment If you have a comment on the research, you can leave it here. Otherwise press the arrow to continue.				
SD in parentheses				

Table B.2. Qualtrics questionnaire
(Example condition: imitation strategy + long supply chain)

Code entry (completed by the researcher)



Introduction + informed consent

Welcome to this research by TU Delft, entitled "New biscuits by TreatTaste"! In this study, you will be asked to **taste and evaluate a newly developed biscuit product and its packaging**.

This study will take approximately 10 minutes to complete and the data collected will be used for research purposes only. All information is anonymous and will remain strictly confidential. Your participation in this study is entirely voluntary and you can withdraw at any time.

Please note: The biscuit may contain potential allergens, including wheat, eggs, milk, soy, and cranberries. If you have any allergies to the ingredients listed, please raise your hand and you can leave the room.

By proceeding, you voluntarily agree to participate in this study, and you confirm that you've read and understood the above information.

I voluntarily agree to participate in this study and have read the text above. I also confirm that I do not have any of the above mentioned food allergies.

Yes, I do

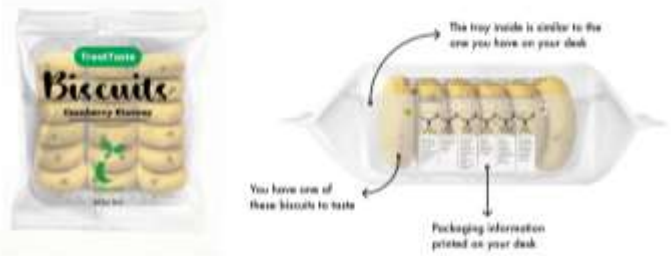
No, I don't

→

Biscuit evaluation

Packaging introduction

Welcome! The company TreatTaste is launching a new biscuit in a new packaging. This is the overall product-packaging they developed. We will ask you to look carefully and evaluate 3 components of this new product-packaging: 1) the biscuit, 2) the packaging tray and 3) the packaging information (see image below).



→

Packaging tray

First, let's look at **the packaging tray** that you have **on your desk** (and that you see in the picture of the final packaging, below). Please have a deep look at this tray on your desk (it is a prototype), hold it in your hands and try to get an impression of it.

→

Packaging information

Second, let's look at the **information**. This biscuit packaging contains some information attached on the side.
We printed this information for you on the paper that you find **on your desk**. Please read all the information on the printed paper on your desk.

→

Biscuit tasting

Now let's start evaluating the **biscuit**. Please **eat the whole biscuit** that you have on your desk and answer the following questions.

→

Biscuit quality evaluation (tastiness, naturalness, freshness)

To what extent do you find the biscuit tasty? Please move the bar to the number you want.

Not tasty at all 1 2 3 4 5 6 Very tasty 7

To what extent do you find the biscuit natural?

Not natural at all 1 2 3 4 5 6 Very natural 7

To what extent do you find the biscuit fresh?

Not fresh at all 1 2 3 4 5 6 Very fresh 7

→

Filler question (thoughts and feedback)

Do you have any additional thoughts or feedback about the product? (e.g., size, shape, crunchiness, etc). If so, please write them here.

Packaging evaluation
Packaging tray

Thank you for having evaluated the biscuit! **Now, the packaging**.

Look again at the tray that you have on your desk. **Please hold the tray in your hand, turn it around and try to engage with it as much as possible.**

To what extent do you find the tray appealing?

Not appealing at all						Very appealing
1	2	3	4	5	6	7

Packaging information

Now look at the packaging information that you have printed on the paper on your desk. **Take some time to read carefully the information provided.**

Yes, I am done reading the information carefully (click)

Emotional responses

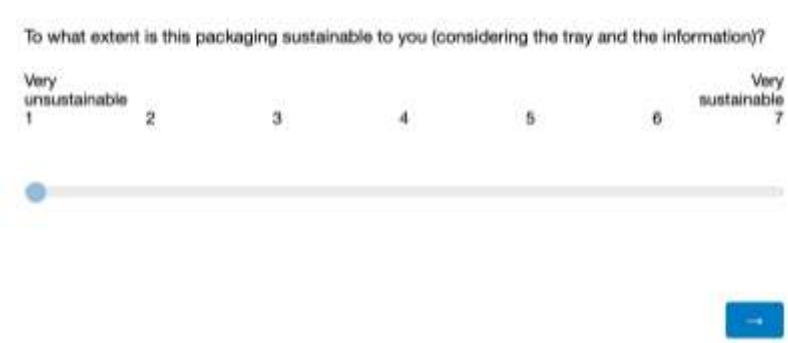
Please select which emotions you feel (all that apply to you) while experiencing this biscuit packaging (considering the tray and the information).

Thoughts and emotions elicited

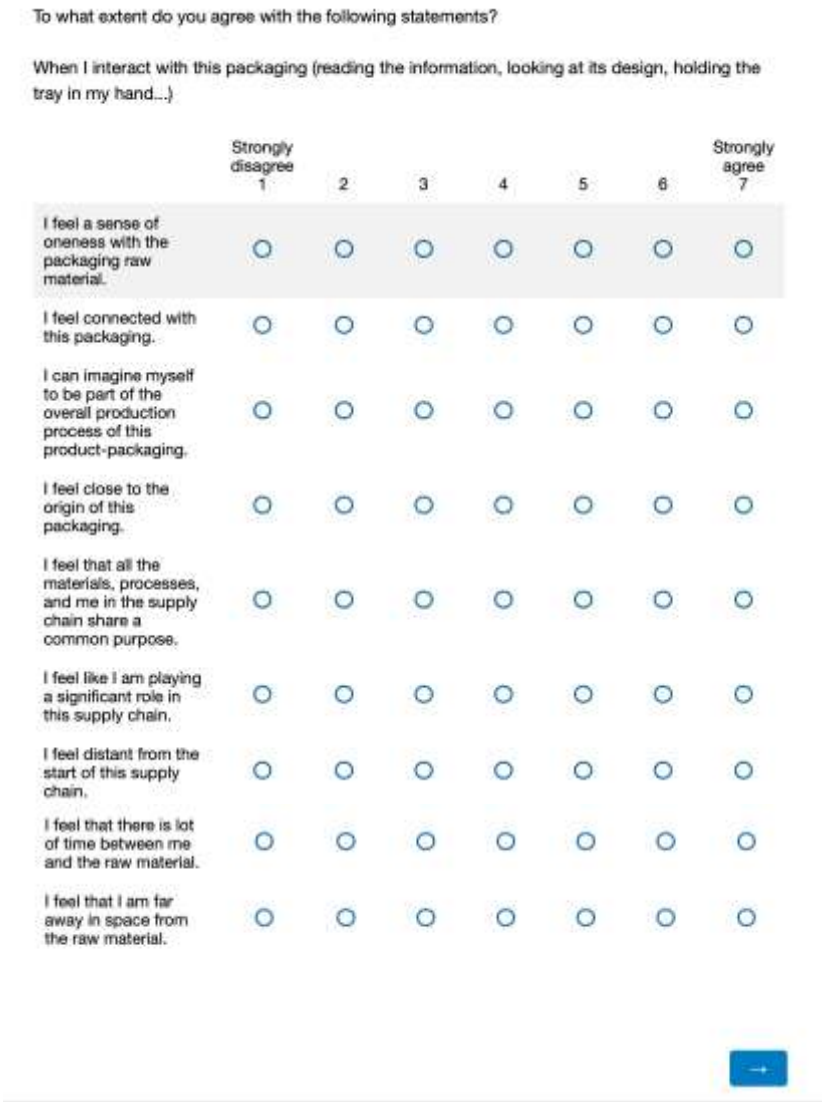
Please describe here why you feel these emotions and all impressions, thoughts, and feelings, that you may have while experiencing this packaging. Please **describe them** in as much detail as possible.

You can re-read the information on your desk and experience the tray again if you need.

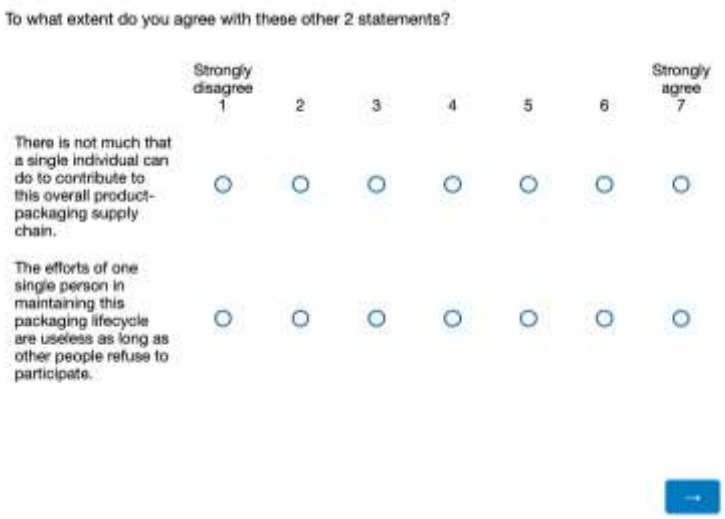
Sustainability perception



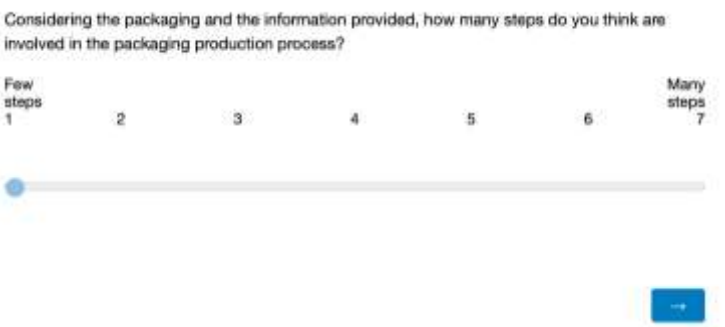
Connectedness to the origin of the supply chain



Perceived consumer effectiveness

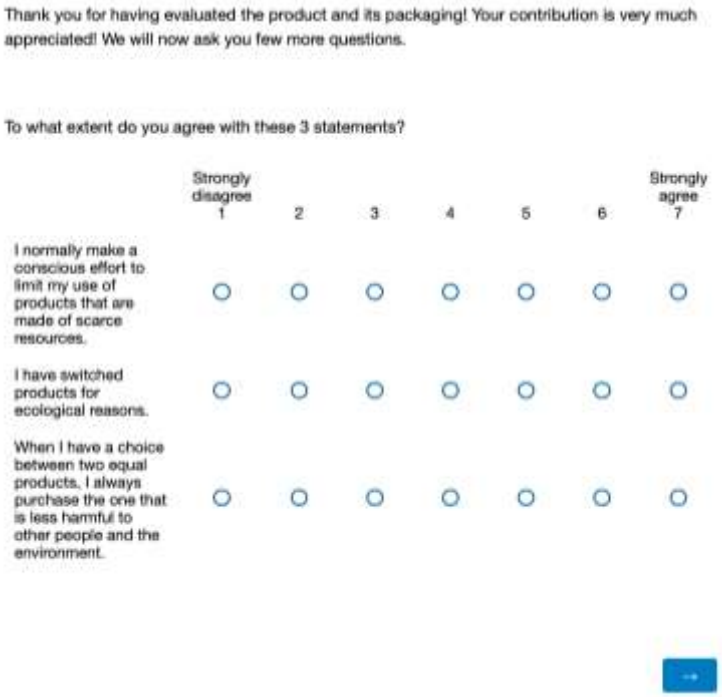


Manipulation check



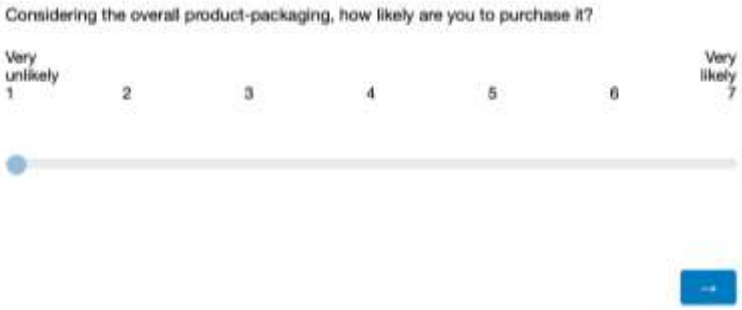
Demographic information

Environmental concern



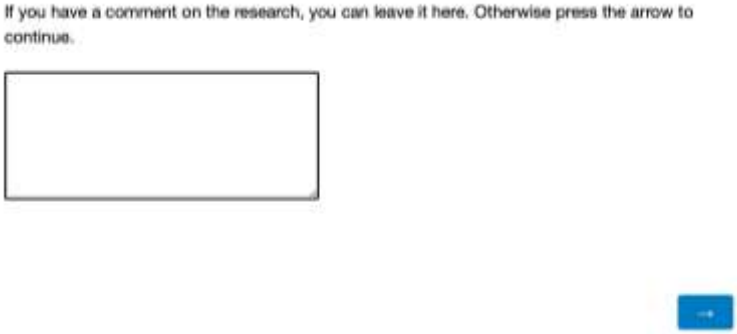
Brand attitude

Purchase intention

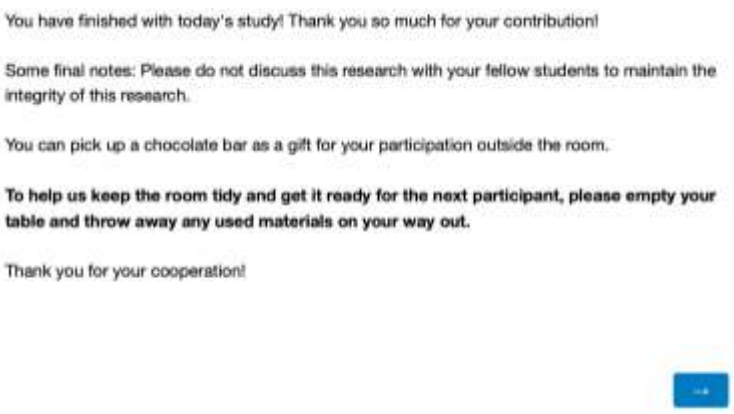


Demographics (gender, age, nationality, town/city)

Comments



Ending + disposal instructions



Appendix C

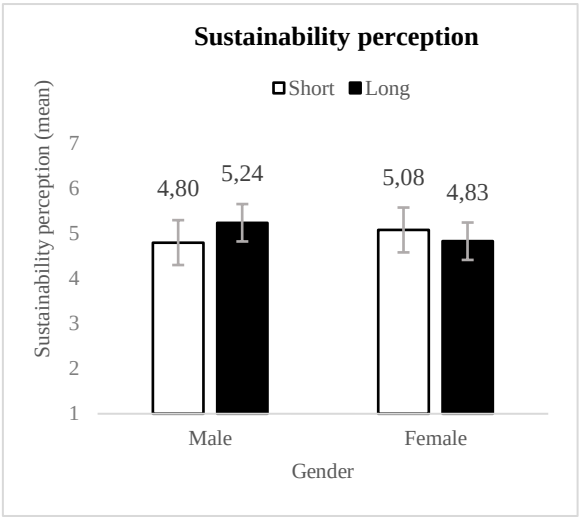


Fig. C.1. Interaction effect between gender and length of supply chain on sustainability perception

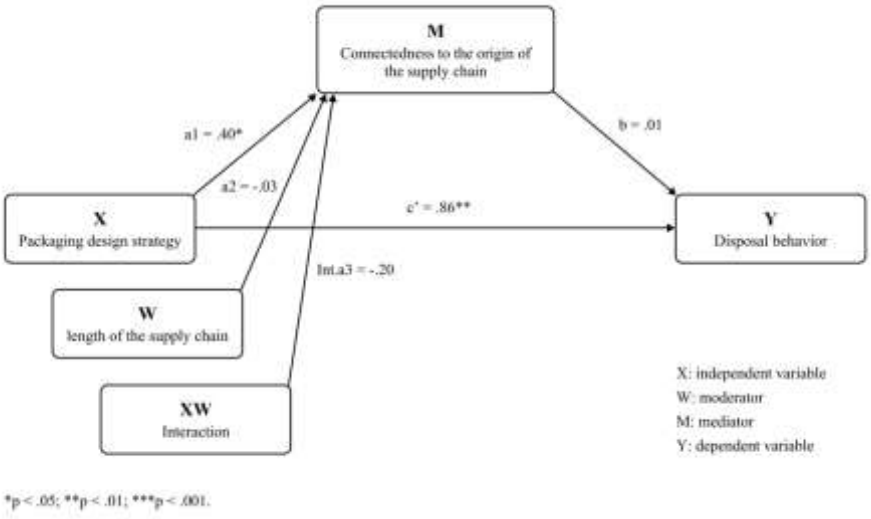


Fig. C.2. PROCESS moderated mediation analysis
(Packaging cues -> connectedness to the origin of the supply chain -> disposal behavior)

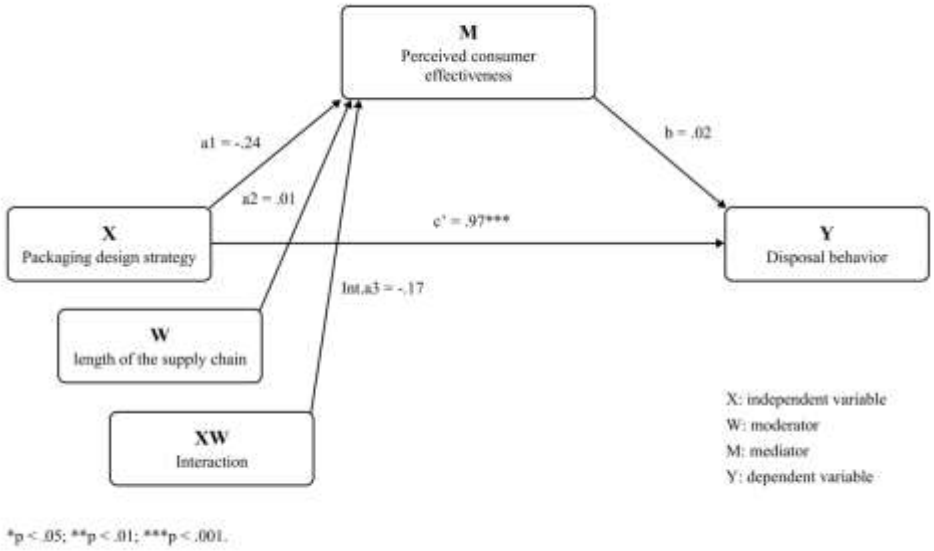


Fig. C.3. PROCESS moderated mediation analysis
(Packaging cues -> perceived consumer effectiveness -> disposal behavior)

Table C.1.
Details on the coding procedure

Code	Meaning and examples of thoughts and feelings mentioned by respondents
Sustainability	References to any aspect of the packaging's sustainability. Examples include descriptors such as "sustainable ", "natural," "ecological," "beneficial for the environment," "ecologically responsible," "socially responsible", as well as labels such as "compostable," "biodegradable," and "bio-based."
Good packaging quality	References to positive qualities of the packaging, including descriptors such as "clean," "strong," "solid," "durable," "flexible," "good texture," "translucent," or "lightweight".
Novelty	Any comment related to the unique or new aspects of the packaging. Examples include words like "different," "unique," "interesting," "new," "curious," "special," "surprising," "different from plastic," or "never seen this before".
Skepticism	Expressions of uncertainty, doubt, or disbelief regarding the sustainability of the packaging. Examples include statements like "scary," "doubtful," "skeptical," "unclear," "not sure," "It's too good to believe," "I don't believe it is truly sustainable," "it raises many questions," or "I find it hard to believe this is beneficial for the environment".
Lack of visuals	Feedback pertaining to the visual design of the packaging, typically indicating a deficiency or desire for more. Examples include "lack of graphic design," "needs more illustrations, symbols, icons, or images," or "needs more visually appealing elements."
Information overload	Comments related to an excess of information displayed on the packaging. Examples include "too much information/text," "information overload," "difficult to read," "repetitive information," "text too long," or "boring to read".

Table C.2.
Extra results of the coding procedure
Four experimental conditions: IL (imitation strategy + long psychological distance), DL (differentiation strategy + long psychological distance), IS (imitation strategy + short psychological distance), DS (differentiation strategy + short psychological distance).

	IL	DL	IS	DS	$\chi 2$ (df = 3); p value
Sustainability	38^{a}	30^{a}	28^{a}	27^{a}	2.43, p = .49
Good packaging quality	11^{a}	6^{a}	6^{a}	9^{a}	2.64, p = .45
Novelty	12^{a}	17^{a}	16^{a}	20^{a}	4.79, p = .19
Skepticism	29^{a}	18^{a}	26^{a}	16^{a}	7.19, p = .07
Lack of visuals	$7^{a,b}$	17^{b}	3^{a}	$5^{a,b}$	13.59, p = .00
Information overload	10^{a}	21^{b}	10^{a}	17^{a}	7.71, p = .05
Unappealing	9^{a}	14^{a}	8^{a}	3^{a}	6.24, p = .10

Columns sharing the same superscript letter are not significantly different at the .05 level (crosstabs with pairwise z-test Bonferroni corrected).

Table C.3.
Frequency of all emotional responses across conditions
Four experimental conditions: IL (imitation strategy + long supply chain), DL (differentiation strategy + long supply chain), IS (imitation strategy + short supply chain), DS (differentiation strategy + short supply chain).

	IL	DL	IS	DS	$\chi 2$ (df = 3); p value
Joy	12^{a}	10^{a}	12^{a}	4^{a}	4.54, p = .22
Satisfaction	17^{a}	17^{a}	11^{a}	13^{a}	1.11, p = .78
Pride	3^{a}	5^{a}	2^{a}	4^{a}	1.36, p = .71
Fascination	46^{a}	39^{a}	39^{a}	40^{a}	2.82, p = .42
Admiration	15^{a}	20^{a}	19^{a}	15^{a}	1.57, p = .67
Desire	4^{a}	20^{b}	3^{a}	2^{a}	29.50, p = .00
Hope	$14^{a,b}$	8^{b}	$15^{a,b}$	18^{a}	7.60, p = .06
Sadness	1^{a}	0^{a}	0^{a}	0^{a}	2.77, p = .43
Skepticism	36^{a}	21^{b}	$32^{a,b}$	$20^{a,b}$	11.27, p = .01
Fear	0^{a}	0^{a}	0^{a}	1^{a}	3.44, p = .33
Boredom	16^{a}	30^{a}	19^{a}	20^{a}	6.35, p = .10
Shame	1^{a}	0^{a}	0^{a}	2^{a}	4.20, p = .24
Aversion	3^{a}	1^{a}	1^{a}	2^{a}	1.53, p = .67
Contempt	2^{a}	0^{a}	0^{a}	1^{a}	3.53, p = .32

Columns sharing the same superscript letter are not significantly different at the .05 level (crosstabs with pairwise z-test Bonferroni corrected).

Appendix D

Fig. D.1. Disposition of the materials on each desk

Fig. D.2. Picture of the bin station

Fig. D.3. Picture of the research lab

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Graduation brief

TU Delft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF
To be filled in by the chair of the supervisory team.

chair Dr. ir. Hende, E.A. van den date 16 - 03 - 2023 signature Ellis van den Hende Digitally signed by Ellis van den Hende Date: 2023.03.16 17:05:04 +01'00'

CHECK STUDY PROGRESS
To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC
Of which, taking the conditional requirements into account, can be part of the exam programme _____ EC
List of electives obtained before the third semester without approval of the BoE

YES all 1st year master courses passed
NO missing 1st year master courses are:

name _____ date - - signature _____

FORMAL APPROVAL GRADUATION PROJECT
To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: APPROVED NOT APPROVED
Procedure: APPROVED NOT APPROVED
comments

name _____ date - - signature _____

Initials & Name X.C Chen Student number 5520436
Title of Project Unpacking the Effects of Packaging cues on Consumer Disposal Behavior

Personal Project Brief - IDE Master Graduation

TUDelft

Unpacking the Effects of Packaging cues on Consumer Disposal Behavior

project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 01 - 03 - 2023 25 - 07 - 2023 end date

INTRODUCTION **

Please describe the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money ...), technology, ...)

The packaging sector is currently being challenged by plastic pollution, packaging-related waste, deteriorating air, soil, and water quality, climate change, and other contemporary concerns (Kumar et al., 2021). As we advance toward a more sustainable future, eco-friendly packaging is needed to address these problems. While there is a substantial amount of literature focusing on consumer acceptance and purchase intention associated with enhanced packaging recyclability in the acquisition phase of consumption, scarce research has investigated the post consumption behaviour (disposal behaviour) of consumers (Trudel et al., 2016; Boz et al., 2020). However, achieving the optimal sustainability in the packaging value chain requires an emphasis not only on steering the product selection but facilitating collection and sorting for recycling, composting, reuse, and waste-to-energy processing, as well as other proper disposal and the processing of sorted packaging (Boz et al., 2020). Improper packaging disposal includes littering, not recycling items that should be recycled and placing packaging into the incorrect waste bins, all of which can engender detrimental environmental consequences. For instance, regarding the misplacement of compostable packaging, it could lead to contamination of the waste stream and reduce the efficiency of the waste management process.

Packaging, serving as a critical element of the product, has the potential to contribute to sustainable disposal behaviours, including recycling behaviour (Boz et al., 2020; Cialdini et al., 1990; Langley et al., 2011). Packaging design can consist of a range of different design elements like colour, size, shape, images, logos, claims. According to Granato et al. (2022), packaging elements can be classified into two categories: explicit cues (e.g., statements, labels, or claims) and implicit cues, such as visual (e.g., colours, overall appearance), tactile, and auditory packaging features.

In conclusion, the context of my graduation design project is in the field of sustainable packaging design, with a focus on reducing waste and promoting more responsible consumer disposal behaviour. The effect of implicit and explicit packaging cues and their interplay on guiding adequate packaging disposal would be investigated. By exploring how these packaging cues influence consumer behaviour, this study aims to provide insights into promoting socially responsible disposal behaviours in order to facilitate transition into a circular, zero waste society.

space available for images / figures on next page

introduction (continued): space for images

image / figure 1: A implicit cue example: fibre texture of a compostable food container made from sugarcane

image / figure 2: A explicit cue example: environmental claim on the packaging of a compostable cup

Initials & Name X.C Chen Student number 5520436

Title of Project Unpacking the Effects of Packaging cues on Consumer Disposal Behavior

Personal Project Brief - IDE Master Graduation

TU Delft

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

The design of packaging plays a crucial role in mitigating environmental impact by minimising waste and promoting sustainable practices throughout the product life cycle. Some prior research has explored implicit and explicit packaging cues and their interplay in stimulating sustainable consumer behaviours (e.g., Magnier and Schoormans, 2015; Krah et al., 2019; Granato et al., 2022). While existing research investigates how packaging design cues can be utilised to facilitate the acceptance of eco-friendly products and shift consumers to make sustainable consumption choices, there is a lack of emphasis on how certain packaging design can foster proper disposal behaviour that contributes to the end-of-life stream of packaging sustainability. Therefore, more efforts into this area are required to gain a holistic understanding of consumer behaviours toward packaging design.
The excessive use of single-use plastic food packaging has led to a significant increase in plastic waste, which poses a severe threat to our environment and health. Therefore, there is a growing need to embrace more sustainable alternatives such as compostable bio-based materials to reduce the detrimental impact of single-use packaging on our planet. Some compostable packaging derived from natural substances, for example mycelium-based packaging, could present a new and distinctive look with its visible fibres and irregular surface (Karana et al., 2018). With insufficient knowledge toward those new bio-based materials, consumers may be confused and unable to access the correct way of disposing of the packaging. Meanwhile, other compostable packaging like bio-plastic, could carry an often similar appearance to its conventional plastics counterparts (Van den Oever et al., 2017; Magnier & Schoormans, 2015). As a result, consumers unfamiliar with the concept of these bio-based materials have difficulty distinguishing them from plastic packaging (Sijtsema et al., 2016), leading to miscategorisation during disposal. (Taufik et al., 2020b).
Implicit and explicit packaging cues have been reported to serve as an indicator for consumers which influence the product evaluation and purchase intention. This research intends to examine whether implicit and explicit packaging design cues and their combination could effectively inform and guide consumers towards proper disposal behaviour.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

This graduation project aims to explore the relation between packaging cues and sustainable disposal behavior through a quantitative research design consisting of two studies. The first study follows a single between-subject design with three different conditions on environmental claims, while the second study will adopt a two-by-two experimental between-subject design to investigate the interaction between explicit and implicit packaging cues.

The research enriches the existing body of literature by extending the focus to the sustainable consumer disposal behaviour. The insights gained from this research could shed light on the optimal combination of packaging cues to improve appropriate packaging disposal.
Thus, this research provides multiple strategies for cues for packaging design. Designers can leverage the findings of this research to create sustainable packaging that not only influences consumers' perceptions of sustainable packaging but also encourages them to make environmentally conscious disposal decisions.
Moreover, policy-makers can also use the research results to develop standardised packaging communication guidelines that would effectively inform and facilitate sustainable disposal behaviour.
Lastly, by aligning their practices with these guidelines, businesses can demonstrate their commitment to environmental values while providing consumers with the tools to reduce their environmental impact.

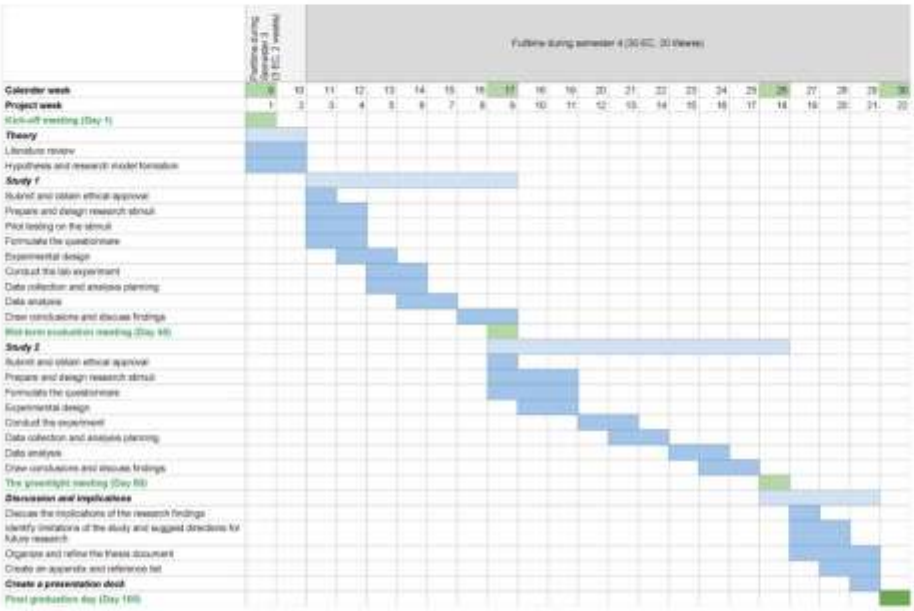
Initials & Name X.C Chen Student number 5520436

Title of Project Unpacking the Effects of Packaging cues on Consumer Disposal Behavior

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 1 - 3 - 2023 25 - 7 - 2023 end date



The aim of this graduation project is to explore the relationship between packaging cues and sustainable disposal behaviour through the implementation of a quantitative research design. To achieve this, the first step would be to review existing literature and formulate the research question and hypothesis. Two studies will be conducted, preceded by a pretest to ensure the manipulation of the design of the claims is justified. The first study will employ a single three way between-subject design, resulting in three conditions (environmental claims: absent vs. functional vs. emotional). For the second study, a 2 (sustainable packaging appearance: conventional-looking vs. sustainable-looking) x 2 (verbal sustainability claim: functional vs. emotional) experimental between-subject design would be adopted to investigate the possible interaction between explicit and implicit packaging cues on consumer disposal behavior. The data collected from the experiments will be analysed and presented in the research discussion, followed by implications for sustainable packaging design.

Initials & Name X.C Chen Student number 5520436

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Personal Project Brief - IDE Master Graduation

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MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

I am excited to embark on a research-focused graduation project to further practise and extend my research capabilities. As a designer, I've always been curious to uncover what users want and need and use those insights to inspire and guide design solutions. Through the prior SPD research experience, I have developed a keen interest in probing and resolving problems through an objective research approach. In this project, I aim to gain a better understanding of consumer attitudes and behaviours to inform business strategies and facilitate sustainable consumer behaviour.

I have obtained fundamental research skills from previous research studies, including the ability to identify research questions, conduct a literature review, collect data, analyse data using appropriate statistical methods, and interpret the findings. Additionally, by participating in the Consumer Behaviour elective course, I got exposed to a variety of relevant theories and deepened my knowledge in the field of consumer research.

However, there are still some competencies that I want to develop and strengthen. As this is my first independent research project, it's crucial to acquire the ability to manage time effectively, coordinate with collaborators, and keep track of project milestones and deadlines. Plus, I aim to broaden my existing knowledge and gain a solid understanding toward packaging design and sustainable consumer behaviour. I also seek to improve my ability in distilling research outcomes to formulate recommendations and solutions that could be applied to address real-world problems. Finally, I want to enhance my ability to communicate the research process and discovery clearly and effectively, both orally and in writing, to a variety of audiences. By building these competencies, I hope to not only contribute to the field of consumer research but also become a better researcher and designer.

In addition, I am interested in conducting a research graduation project on sustainable packaging design, with a specific focus on disposal behaviour, for several reasons. Firstly, packaging waste is a significant environmental issue that contributes to pollution, greenhouse gas emissions, and resource depletion. Secondly, sustainable packaging design has the potential to reduce the negative impact of packaging waste on the environment and human health. Thirdly, studying disposal behaviour can provide insights into consumer attitudes and behaviours towards sustainable packaging, which can inform the development of effective interventions to promote sustainable packaging practices. Overall, I believe that this research area has the potential to contribute to the advancement of sustainable development and foster positive environmental outcomes.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.