INNOVATION FOR SUSTAINABILITY

Disruption of company and consumer routines to facilitate sustainable behavioural change

Giulia Granato

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Propositions

1. Identification and management of misalignments between users and designers represent a strategic learning tool for new product development processes. (this thesis)

2. "The Meaningful Reminder" represents an effective design strategy in communicating sustainable innovations to consumers. (this thesis)

3. Societal acceptance that scientific truth is work-in-progress enhances trust in scientific findings.

4. Imagination is the engine of scientific progress.

5. Scientific progress redeems mankind from its history.

6. Variation within cultures is undervalued compared to variation between cultures.

7. Being pessimistic is easier than being optimistic.

8. For PhD self-confidence, strengthening strengths is underrated compared to strengthening weaknesses.

Propositions belonging to the thesis, entitled

Innovation for sustainability- Disruption of company and consumer routines to facilitate sustainable behavioral change

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Innovation for sustainability

Disruption of company and consumer routines to facilitate sustainable behavioural change.

Giulia Granato

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Innovation for sustainability

Disruption of company and consumer routines to facilitate sustainable behavioural change.

Giulia Granato

Thesis

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Dietro ogni norma,
dietro ogni tecnica,
c'è un uomo che compie scelte in base al suo libero arbitrio;
e noi dipendiamo da quello,
dalla sua scala di valori,
dal rispetto per gli altri che lo anima,
dal suo senso del dovere.

Antonio Polito (journalist)

[English translation]
Behind every norm,
behind every technique,
there is a man who makes choices based on his free will;
and we depend on that,
on his scale of values,
on the respect for others that animates him,
on his sense of duty.

1

Chapter I
General Introduction

1.1 Sustainability and fast-moving consumer goods

It is widely recognized that our current patterns of mass production and consumption have not only contributed to welfare, but also created immense environmental problems, profoundly contributing to pollution, global warming and destruction of natural resources (Behun et al., 2018; Krausmann et al., 2009; Oreskes, 2018). The industry of fast-moving consumer goods is a key player in this environmental crisis. Unlike other goods, from electronics to cars, from houses to furniture, fast moving consumer goods (as food and household products) are frequently purchased and rapidly consumed. Because of their short shelf-life, these goods are mass produced, widely distributed and sold on large scales at low prices (Kenton, 2020; Muranko et al., 2021). Their definition as *fast moving* consumer goods or, alternatively, as *packaged goods* recalls their limited durability (often almost disposable) and the pervasiveness of their packaging (also rapidly reduced to waste), both highly contributing to the environmental impact (Hertwich, 2010; Shahmohammadi et al., 2020).

The decision-making process for fast moving consumer goods differs from the one involving more durable goods, both from the consumption and production point of view. While choosing a car or a house poses a high level of risk to the buyer, a low risk is involved in choosing a cucumber in front of a supermarket shelf, whose decision-making occurs quickly, repeatedly and with low involvement (Kenton, 2020). Similarly, the manufacturing of fast moving consumer goods generally promises a reliable and stable source of revenue due to the high volume of sales (Kenton, 2020). The extremely fast, highly repeated, and competitive production of fast-moving consumer goods has led companies to constantly optimize their processes, progressively leading to the development of increasingly standardized practices and routines.

As often noted in the innovation management literature, organizations develop "routines" for their activities, that gradually become standardized and well-established into the company policies, structures, and processes (Arrow, 1962; Nelson & Winter, 1982; Seebode et al., 2012). A well-rehearsed production, as the one of fast-moving consumer goods, with low involvement from customers and low margins for companies (on individual sales), may be less incentivized to allocate resources away from established technological and market trajectories (e.g., working with the same suppliers,

resources, know-how) (Jurgilevich et al., 2016; Southerton et al., 2004). As a consequence of these highly efficient routinized behaviours, companies may find themsleves unable to "think outside the box", anchored to their "business as usual" and to their inertia (i.e., the organization inability to enact an internal behavioural change in face of an external change) (Gilbert, 2005; Miller & Friesen, 1980; Tushman & Romanelli, 1985).

Routines have been claimed to be particularly restrictive in fast-changing environments and market conditions, where the emergence of new problems demands for a greater openness to new solutions (March, 1991). The environmental crisis requires companies to challenge and re-think their established practices, moving beyond their "status quo". The incorporation of sustainability considerations into production processes may involve working with different knowledge, customers and suppliers or with new technologies, markets and resources (Seebode et al., 2012). To deal with these changes and embrace a window of new opportunities towards a more sustainable development, organisations may need to disrupt their routines and step away from their inertia (Leonard, 1995; Mousavi et al., 2018).

The development of routines does not only characterize business practices and companies' decision making but is also evident in consumer activities and behavioural patterns. Many activities that consumers perform (e.g., shopping, commuting, household activities etc..) happen in stable contexts, becoming habitual and being carried out automatically. Fast, recurrent and low involvement consumption patterns, as those of fast-moving consumer goods, strengthen the stability of the shopping context and favour the development of consumer routines. For example, all the activities that involve the consumption of food products, including their choice, consumption, disposal and re-purchase, consist of habitual practices that are implemented almost automatically in response to specific cues (Jurgilevich et al., 2016; Southerton et al., 2004). Such automaticity of actions allows consumers to avoid spending precious cognitive resources every time they go shopping. However, it also leads to a tunnel vision, making consumers less sensitive to detect changes in the environment (e.g., the addition of a label on a packaging). As a result, consumers tend to overlook new information or better alternatives that may arise (e.g., a new more sustainable packaging alternative) (Fazio et al., 2000; Fujii et al., 2001).

All the activities mentioned above, from the choice of a product to the disposal of its packaging, largely impact on the environment (Crippa et al., 2021) and represent targets for behavioural change towards a more sustainable direction (Notarnicola et al., 2017). Breaking the automatic flow of "shopping as usual" and disrupting from consumers' routines may open a window of opportunity, in which consumers may detect changes in the shopping environment, search for further information and rationally consider alternative (more sustainable) courses of action (Betsch et al., 2001; Fazio et al., 2000; Fujii et al., 2001; Verplanken & Wood, 2006).

The consideration and adoption of "alternative courses of action", both in the production and consumption system, is central in the sustainability debate. In this context, research has often highlighted that the currently established practices are untenable, and that change is the condition *sine qua non* for a more sustainable development (Bruijnes et al., 2020; Kardos, 2012; Klaniecki et al., 2016; Mulder, 2007). The interlink between change and sustainability is evident in the concept of sustainability *transition*, involving a whole range of changes (Mulder, 2007; Rotmans et al., 2001), and in the concept of sustainability as a *moving target*, rather than a stable end-state (Bagheri & Hjorth, 2007; Curran, 2009; Hjorth & Bagheri, 2006; Hjorth & Madani, 2014). As circumstances continuously change and new knowledge is coming along, sustainable development is always moving, ongoing and emerging, as is the need for a more sustainable development and behavioural change (Bossel, 1999; Mitroff & Linstone, 1995; Veeman & Politylo, 2003).

It thus becomes imperative to develop theoretical insights and practical tools that help navigate towards the moving sustainability target (Hjorth & Madani, 2014). From a business perspective, companies require insight into the tools that may guide their behavioural change towards a more sustainable development (Kennedy et al., 2017). While it is evident *that* change is at the core of a more sustainable future, it is less clear *how* this change can be encouraged and the innovation path can be managed (Seebode et al., 2012). It becomes, therefore, essential to understand how *companies* can be equipped with proper tools and processes to disrupt their "business as usual", moving them beyond inertia and resistance to change.

Looking at consumer inertia, as the other side of the same problem, it is pivotal to understand how *consumers* can be guided in the disruption of their

routines, as these may obscure available (more sustainable) alternatives and hinder the adoption of a new (more sustainable) lifestyle. Specifically, it is essential to understand how consumers can step out from their "consumption as usual" and recognize the added value of a more sustainable innovation (e.g., resource-efficient product, new waste reduction method, recycled material) (Sethi et al., 2001), whose actual environmental improvement critically depends on consumer adoption. This implies that, even when companies manage to step away from their inertia (e.g., developing an innovative and more sustainable technology), consumer recognition of these business efforts and achievements is pivotal.

Therefore, in studying how companies and consumers can think, develop and behave beyond their status quo, it is important to consider how these two players (companies and consumers) interact with each other: on the one hand, how *companies* can use consumer insights to step away from their routines, towards more sustainable production patterns and, on the other hand, how *consumers* can use business efforts to step away from their routines, towards more sustainable consumption patterns.

By integrating the two perspectives (business and consumer) on the same challenge of routine disruption, this thesis contributes to the understanding of how company and consumer routines can be disrupted to pave the way towards a more sustainable behavioural change. To validate theoretical insights and practical tools on routine disruption, the research presented in this thesis was conducted within an existing European consortium of food packaging innovators, as research context.

In the next sections, the theoretical background on companies' routines, product-consumer interaction and consumers' routines is provided, to stress the knowledge gaps and relevance of the following thesis chapters. This introductory chapter then provides further insights into the European consortium "MYPACK" as the research context of this thesis. A thesis overview section follows, with research questions and chapters' outline.

1.2 Disrupting companies' routines and inertia

Company practices are often organized around a series of routines that are formed through the knowledge that an organization stores in its "memory"; in its procedures, rules, norms and forms (Day, 1994; Guha, 2015; March, 1991). Such well-established and repeated behavioural patterns have gradually determined the "best practices" of a company (Guha, 2015). What has been shown to work in the past is embodied in these "best practices" and is carried on to the present. Routines and standardized approaches reduce costs and speed up execution, allowing to make decisions in a limited amount of time, demanding little attention from the actors of the routine (Kyriakopoulos & De Ruyter, 2004). For example, a long and trustworthy relationship with suppliers may flow into "the best practices", allowing the firm to carry on this relationship almost automatically, with a safe and reliable supply of materials whenever needed. In stable contexts, well-exercised and standardized methods (such as linear stage-gate practices) have been recognized to be beneficial in proving confidence and structure, crucial in the new product development (NPD) activities (Kyriakopoulos & De Ruyter, 2004; Seebode et al., 2012).

However, as often noticed in innovation management literature, routines can be so strongly rooted within the company processes that they create a tendency towards conservatism and "innovation redundancy", where traditional and established models are strongly favoured (Day, 1994; Kyriakopoulos & De Ruyter, 2004; Seebode et al., 2012). This can be evident in several new product development (NPD) practices, from supply-chain relationships to the incorporation of consumer demands. For example, a routine-based relationship with suppliers could make the company hesitate in adopting new materials (maybe more sustainable), as these may imply the identification of new set of supply chain partners, instead of relying on the established and well-rehearsed ones. Also in the context of "new product creativity", routines favour those products that align with existing consumer demands, at the disadvantage of those options that misalign with the status quo, but could proactively anticipate emerging and future demands (Sethi et al., 2001). As a result, companies run the risk of being always a step behind the dynamic and fast changing market.

Overall, routines and conservatism in NPD practices lead, in the long run, to an "organisational inertia", which prevents companies from being flexible

and adaptive to changes (Day, 1994; Seebode et al., 2012). As "core rigidities" (Leonard, 1995), routines filter information flows to fit established assumptions. They also have been found to hamper companies' ability to perceive and deal with changing conditions (Kyriakopoulos & De Ruyter, 2004).

To better address these changing contexts, agile and flexible NPD methods have been advocated, as opposed to linear stage-gate practices. "Dynamic capabilities" have been requested from companies, to renew, adapt and edit their routines (Teece et al., 1997). Research on sustainable innovation has highlighted the problem of favouring the status quo over "new architectures", recognising that sustainability asks firms to take new perspectives, to radically challenge the status quo and "think outside the box" (e.g., redefining costumer needs, identifying new supply chain partners or new technologies) (Hellström, 2007; Huesemann, 2003). In this regard, companies need to have the capability, as well as enabling tools and methods, to embrace a window of new opportunities, which may pave the way towards a more sustainable development (Seebode et al., 2012; Zahra & George, 2002).

Acknowledging companies' inability to deal with changing conditions due to routines (i.e., organizational inertia), research both in innovation management and in the sustainability domain, has turned its attention on routine disruption (Anderson Jr & Lewis, 2014; Guha, 2015; Turner & Rindova, 2012; Zellmer-Bruhn, 2003). While advocated, it is unclear how companies can be guided in this process of routine disruption, by integrating in their NPD process more proactive methods, less anchored in rigid routines and able to give value to misalignments from the status quo (Seebode et al., 2012; Kennedy et al., 2017).

This thesis contributes to this knowledge gap in chapter II, by bringing theoretical insights and developing a practical tool for this purpose. Specifically, chapter II investigates how companies can use consumer insights to step out from their inertia and develops a new NPD method to guide companies in this process; in the identification and proactive management of misalignments from the "status quo".

1.3 Product-consumer interaction

In studying how companies can use consumer insights to move away from their inertia, it is important to understand how companies interact with consumers. Such understanding is crucial in the context of sustainability, as it is a shared responsibility between companies and consumers. Even when companies manage to step out from their inertia (e.g., developing an innovative and more sustainable technology), consumers' recognition of these business efforts is decisive for the actual environmental improvement. Likewise, even when consumers are willing to enact a more sustainable behavioural change, business efforts must go hand in hand, for a real sustainable development. Taken together, these considerations imply the need to understand the processes underlying company and consumer decision-making and their interaction (Brunswik, 1955; Olson, 1978; Steenis, 2019; Steenkamp, 1990).

Company decision-making process in product design can be delineated as *top-down* process, through which companies' values (e.g., honesty, integrity, commitment to costumers) and goals (e.g., quality, convenience, sustainability etc..) are translated into an offer of relevant benefits (e.g., easy to open packaging), that are, in turn, incorporated into a set of concrete cues in the physical product design (e.g., tear-off lid) (Bloch, 1995; Golder et al., 2012; Ratneshwar et al., 2003).

Consumer decision-making process, instead, is typically viewed as *bottom-up* process: from the concrete product cues (e.g., biodegradable material) with which they are confronted, consumers infer relevance and meaning for the psychological consequences (e.g., naturalness, sustainability) that the product is believed to signal (Gutman, 1982; Gutman & Reynolds, 1988; Olson & Reynolds, 2001). These inferred consequences are, in turn, instrumental to the individual's goals (e.g., make a sustainable choice) and values (e.g., protect nature, being a responsible citizen) that can be fulfilled through the consumption or use of products (Brunsø et al., 2002; Gutman, 1982; Pieters et al., 1995; Steenkamp, 1990).

It is important to note that consumers can infer multiple psychological consequences from the same product cue and that these can have, at the same time, both a positive and negative connotation. For example, consumers may both infer a *higher* sustainability and a *lower* convenience from the same

packaging cue such as a biodegradable material. This occurs because these inferred consequences, in terms of perceived benefits and sacrifices, are cognitively interlinked (Luchs et al., 2010; Magnier & Schoormans, 2015; Pancer et al., 2017). When such mixed inferences (positive and negative) are perceived, consumers face a trade-off, which ultimately affect their evaluations and decisions. For example, based on the subjective importance that consumers attach to each perceived consequence, consumers may or may not be willing to compromise and trade-off convenience for a higher level of sustainability. Sustainability is indeed only one of the many inferred consequences and only one of the many relevant criteria in consumer decision-making. As a result, it is important to investigate how consumers trade-off and compromise between all the perceived consequences, as this ultimately affects consumer evaluations and preferences for sustainable design alternatives.

Although the trade-off between benefits and sacrifices derived from a more sustainable product design is central in the designers' perspective, it is generally overlooked in consumer research. Prior consumer research has mainly addressed sustainability as a concept per se (Herbes et al., 2018; Ketelsen et al., 2020; Lindh et al., 2016; Steenis et al., 2018), but hardly in relation of other (potentially) competing consequences or, in other words, from the perspective of a benefit-sacrifice trade-off.

This thesis contributes to this knowledge gap in chapter III, by integrating a trade-off perspective to the study of product-consumer interaction in sustainable product design. In addition, acknowledging that consumer characteristics (such demographic factors as age and gender or physiographic ones as values and goals) influence consumer decision-making process and its inherent trade-offs (Bettman et al., 1998; Steg et al., 2014; Thøgersen & Ölander, 2002), chapter III takes into account representative consumer characteristics across Europe.

1.4 Disrupting consumers' routines and inertia

Disruption of routine and inertia has not been a topic only in the innovation management literature but also in consumer research. Many activities that consumers perform and that represent typical targets for a more sustainable behavioural change are determined by routines. Routines are intended as a form of automaticity in responding to contextual cues (Lanzini, 2017;

Verplanken, 2006; Verplanken & Aarts, 1999). Such automaticity of acts has been found to influence information search and consumer decision-making. First, automaticity leads consumers to search less extensively for information about context and the available alternatives (Verplanken et al., 1997). Second, under automaticity, information search tends to be biased towards confirming past and existing behavioural patterns, rather than exploring new counter-habitual information that may challenge "the status quo" (Betsch et al., 2001; Betsch et al., 2004; Heckhausen & Beckmann, 1990; Verplanken & Orbell, 2003). Third, automaticity and routines appear to decrease the complexity of consumers' decisions about an action, in favour of simple and short-term decision rules. Last, routines hamper detection of changes: as consumers expect prior experiences to repeat, they do not easily detect changes in their surrounding environment, overlooking new and better alternatives that may arise (Fazio et al., 2000; Fujii et al., 2001).

Taken together, these characteristics of routines represent crucial vulnerabilities in the context of sustainable development. Sustainability asks consumers to search for new information (e.g., labels on new technologies), to consider alternatives that may challenge the "consumer behaviour as usual" (e.g., new packaging materials that require a different disposal behaviour), to engage in a more complex decision-making (where, e.g., long-term societal benefits are considered over short-term individual benefits) and, primarily, to detect changes in the environment (e.g., a distinctive and maybe more sustainable packaging material in the habitual shopping context).

Recognition and detection of changes in a new product represents a central topic in the pursuit of product design and creativity (Michaut, 2004; van Trijp & van Kleef, 2008). The notions of "recognised relevance" and "meaningful uniqueness" highlight the importance of recognizing uniqueness in a new product and of signalling that something has changed (Amabile, 1983; Sethi et al., 2001). The idea of sustainability as a "credence attribute" (Vermeir & Verbeke, 2006) reminds us that sustainability cannot easily be detected or assessed, risking to go unnoticed and prevent a sustainable behavioural change. For example, only after recognizing the distinctiveness of a new biodegradable and compostable packaging (compared to its conventional counterpart), consumers can subsequently undertake the necessary change in their disposal behaviour (e.g., in the organic bin instead of that for the

plastic). The stronger the routine, the harder it is for consumers to step out from their inertia, namely to detect external changes and enact an internal behavioural change (Verplanken & Roy, 2015, 2016).

Acknowledging consumers' inability to detect and enact changes due to routines (i.e., consumer inertia), research in consumer behaviour has advocated routine disruption (Albarracín et al., 2005; Derzon & Lipsey, 2001; Lodish et al., 1995; Orleans, 2000; Smith et al., 2004; Verplanken, 2006). Although recognized as a key element for change, disruption of consumers' routines and inertia in the context of sustainable behavioural change deserves further investigation. In this regard, it is relevant to further understand the role of new product design in disrupting deeply rooted behavioural patterns, towards a window of new opportunities for sustainable behavioural change.

This thesis contributes to this understanding in chapter IV, by bringing theoretical insights and developing a practical tool for this purpose. Specifically, chapter IV investigates how consumers can use business efforts in product design to step out from their inertia and it develops a new design strategy to guide consumers in this process; in the recognition of sustainability and in the implementation of a more sustainable behaviour.

1.5 Research context: food packaging innovations and MYPACK project

To validate theoretical insights and practical tools on routine disruption, this thesis uses a European consortium of food packaging innovators, MYPACK, as research context. Created in 2017 with the support of the European Union, the MYPACK project offers a realistic and diversified setting, in terms innovations, disciplines (food and packaging companies, research institutes and universities) and countries involved (the Netherlands, Germany, France, Italy and Greece).

The aim of the MYPACK is to minimize the "redundancy perspective" of packaging, as a negative contributor to the environmental impact and to improve its "facilitator perspective", as beneficial and added value to the supply chain. Acknowledging that our mass production-consumption systems strongly rely on packaging to maintain product quality, prevent product losses, facilitate transportation and storage and communicate information (Lindh et al., 2016; Steenis et al., 2017), the MYPACK project considers packaging as a potential facilitator of the sustainability transition.

For its role as facilitator, packaging has increasingly gained interest among consumers, companies, science, society at large and policy makers, within and beyond the EU project MYPACK (Coussy et al., 2013; Guillard et al., 2018; Licciardello, 2017). In this regard, actions are demanded to understand how companies and consumers can become key players in the packaging sustainability transition.

Although increasingly important for both companies and consumers, the integration of packaging sustainability in company and consumer decision-making process is challenging. Looking at the business perspective, food packaging production has long been optimised for its primary roles of transport, preservation and sale of goods, using fossil fuel-based materials (Kassaye & Verma, 1992). For decades, packaging production systems have followed a linear perspective: materials were extracted from the environment and waste was disposed of, with little attention to circularity (Bruijnes et al., 2020). These practices have been progressively consolidated in companies' mindset, determining routines and conventions in the packaging production. Although packaging sustainability has been acknowledged as relevant and strategic by companies (De Koeijer et al., 2017), improvements have mainly taken place in an incremental mode (e.g., replacing virgin materials with recycled ones, incrementally improving energy use, new design only marginally different from conventional ones) rather than radical (e.g., a radically new-ecological ink, non-toxic, biodegradable and easily removable from a paper packaging) (Bruijnes et al., 2020; Dangelico & Pujari, 2010; De Koeijer et al., 2017; Hellström, 2007). Strongly favouring the status quo over "new architectures", packaging production has long remained hesitant or resistant to embrace changes in a more sustainable direction (Bruijnes et al., 2020; De Koeijer et al., 2017; García-Arca et al., 2017).

Considering the consumer perspective, it is also challenging to get consumers to integrate sustainability in their packaging decisions (Steenis et al., 2017). Routines and conventions have been built not only from the side of the supply but also from the side of the demand, in terms of learned associations between packaging cues and (functional) expectations. As consumers have limited knowledge on packaging sustainability, they rely on their own lay beliefs of what the packaging should provide and signal, for example in terms of convenience, protection, preservation or aesthetic

quality and may not spontaneously include sustainability in their purchase decisions (Steenis et al., 2017). Due the highly repeated purchasing of packaged foods, these associations between packaging cues and consumer benefits have been progressively consolidated in consumer memory and may be difficult to change or disrupt.

These characteristics of the food packaging sector, next to the accessibility to the MYPACK project, contributed to the relevant and practical applicability of this thesis on routine disruption.

1.6 Thesis overview

This thesis contributes to answer the following research question:

How can we facilitate the disruption of companies and consumers' routines to pave the way towards a more sustainable behavioural change?

First focusing on the company perspective, this thesis begins with understanding how *companies* can be guided in the process of routine disruption, centring around the research question:

RQ1: How can companies use consumer insights to step out from their inertia and how new product development (NPD) methods can guide in this process?

Chapter II provides theoretical insights into this research question and develops a method, named as *MUD-Misalignments Users-Designers*, that helps companies integrate in their NPD activities, a more proactive and future-oriented attitude, able to overcome organizational inertia and give value to misalignments from the status quo. Through a qualitative study applied in the realistic MYPACK consortium of food packaging innovators, this chapter guides companies in the systematic identification and exploration of misalignments between their designers and users. Moreover, this chapter contributes to the study of product-consumer interaction, by simultaneously investigating company and consumer decision-making, as a top-down (from goals to cues) and bottom-up process (from cues to goals), respectively.

After having delved into company perspective on routine disruption, this thesis extends the research focus on consumer decision-making, and specifically, on how consumers trade-off the psychological consequences,

inferred from the physical product design. This centres around the research question:

RQ2: How do consumers respond to trade-offs inherent in their decision-making process involving sustainability?

Chapter III contributes to answer this research question, by integrating a trade-off perspective to the study of product-consumer interaction. As subjective in nature, the trade-off is investigated across contextual factors and consumer characteristics, such as age, gender, values and goals, which play a role in consumer decision-making. Through a large representative survey among 5035 consumers in five different European countries, this chapter provides detailed insights into all the associations that design cues hold with benefit perceptions and how these ultimately affect consumers' decisions involving sustainability.

By studying cues-benefits associations, this chapter represents a preliminary step in understanding how consumer established associations and routines can be disrupted, which is the focus of the following chapter, centred around the research question:

RQ3: How can consumers use business efforts to step out from their inertia and how product design can guide in this process, towards a more sustainable behavioural change?

Chapter IV provides theoretical insight into this research question and develops a design strategy, named as *The Meaningful Reminder*, to guide consumers towards a more sustainable behavioural change. Through a series of lab studies with physical prototypes, this chapter investigates how product design can facilitate recognition and perception of sustainability and encourage sustainable consumer behaviour.

Chapter V concludes this thesis by reflecting on the three research angles through which this thesis approaches the topic of routine disruption and (packaging) sustainability transition: an innovation management angle (chapter II), a consumer behaviour angle (chapter III) and a communication angle (chapter IV). An overview of the main findings is also provided, next to a discussion of research contributions, limitations and avenues for further research. *Figure 1.1* provides a schematic visualization of this thesis outline.

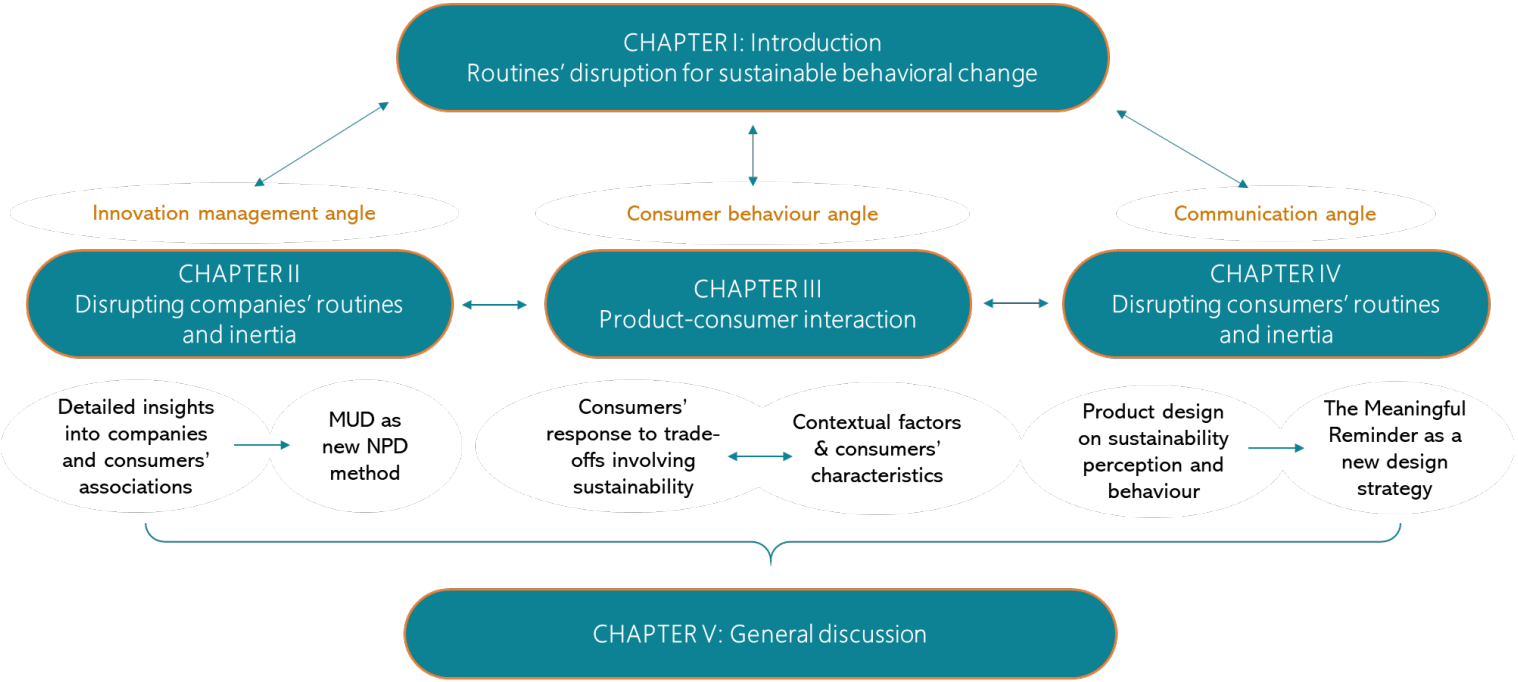

Figure 1.1: *Thesis outline*

2

Chapter II

Misalignments between users and designers as source of inspiration: a novel hybrid method for physical new product development.

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Abstract

This chapter replies to the call for more agile-stage-gate hybrid methods in the context of physical innovations. By showing how some of the characteristics of conventional linear stage-gate methods and of the agile approaches can be integrated, we propose and test a new form of hybrid method for the physical new product development process (NPD).

Distinguishing itself from the conventional NPD methods and practices, biased towards alignments between companies and consumers as the key to market success, our method focuses on the innovation potential intrinsic to misalignments. Through a qualitative study applied in an existing European consortium of innovators, a new method is proposed and tested to guide companies in the systematic identification and exploration of misalignments between their designers and users.

By identifying misalignments at specific level of the NPD process, our method provides companies with a deep analytical insight and awareness into how, where and why (mis)alignments between their designers' decisions and users' demands might occur. Moreover, by supporting companies in the exploration of the misalignments as informative, beneficial and inspirational aspects of their NPD process, this chapter offers a strategic learning and reflection tool to proactively manage the identified misalignments to the advantage of the innovation process.

Keywords: stage-gate, agile, new product development, hybrid methods, physical product innovation, misalignments between companies and consumers, packaging.

2.1 Introduction

Innovation, the strategic adjustment of business propositions to changing market conditions, is essential to the company's profitability, growth and continuity (Anderson et al., 2014; Baregheh et al., 2009), and particularly in times of high market turbulence (Bodlaj & Čater, 2019). One kind of innovation is product innovation that we conceptualise as the translation of a business idea into a physical novel "artefact" (Grunert & van Trijp, 2014). As a novel bundle of physical features, innovative artefacts gain meaning and relevance through perception; through the instrumental and perceptual associations that the concrete product features hold with the benefits that the company aims to deliver and communicate (Grunert & van Trijp, 2014). Product innovations differ in innovativeness, ranging from imitation (existing features signalling established benefits in the marketplace), to incremental innovation (new features or a novel combination of features that better fulfil existing benefits), to radical innovation (new features signalling new benefits) (Chandy & Tellis, 2000; van der Duin et al., 2014). The development and introduction of new carefully selected features-benefits combinations is so vital for companies that it has been defined as "life blood of corporate survival and growth" (Zahra & Covin, 1994). As a result, new product development (NPD) has generated great interest among practitioners and researchers across different disciplines (Baregheh et al., 2009), focusing on how to make sure that the product innovation process is successful (Cooper & Kleinschmidt, 1987; D'Attoma & Ieva, 2020; Ernst, 2002; Frattini et al., 2012; Lins et al., 2019; Van der Panne et al., 2003).

Despite the large amount of research into successful product innovation (Cooper, 2019; Giesen et al., 2007; Griffin et al., 2009; Konietzko et al., 2020), the success rate of new products is still very low (Cooper, 2019; van Trijp & van Kleef, 2008). Despite all efforts and investments into the development and testing, it is estimated that around 40% of new products fail at launch (Cooper, 2019). Data between 2011 and 2013 showed that 76% of the innovations failed within one year after introduction (Dijksterhuis, 2016; Nielsen, 2016).

The success of new products largely derives from consumer adoption, based on the "recognized relevance", namely that consumers recognize the added value of the new product, in terms of distinctive positioning and relevance to their needs and demands (Amabile, 1983). Understanding consumers'

needs and demands is essential to product innovation, often reflected in "incorporating the voice of consumers" into the NPD process (Busse & Siebert, 2018; Cooper, 2019; Horvat et al., 2019; Morgan et al., 2018; Zhang & Xiao, 2020). Developing new products that fulfil existing consumers' needs, wants, and demands is at the heart of a reactive market orientated approach followed by many companies (Jaworski et al., 2000; Slater & Narver, 1998; Van Kleef et al., 2005). However, consumers' needs and demands are inherently dynamic, as recognized in the proactive market orientated approach according to which the NPD process must track and anticipate changes in market demand and structure (Brege & Kindström, 2020; Narver et al., 2004; Von Hippel, 1986). Companies' conservatism, namely their incapacity to proactively capture and anticipate emerging and future market needs, represents one of the key recognized factors for high innovation failure rates (Bessant, 2001; Datta & Jessup, 2013). Without foresight beyond the current market, companies may not be able to fully explore their innovation potential, running the risk of doing "too little, too late", instead of introducing new and relevant features-benefits combinations to the market (Dahlin & Behrens, 2005; Rice et al., 2001; van den Ende et al., 2008).

The conventional linear NPD methods and practices, based on the stage gate process (Cooper, 1990; Cooper & Edgett, 2006; Cooper & Kleinschmidt, 2001), reflect and contribute to this inability, as they tend to constrain and confine the company to the current market. Although these gate stage methodologies are still the most dominant and widely adopted NPD approaches by over 60% of companies worldwide (Cooper & Kleinschmidt, 2001; Griffin, 1997b; Grönlund et al., 2010; Kalluri & Kodali, 2014), they have been the subject of concern and criticism (Bers et al., 2014; Bianchi et al., 2020; Hutchins & Muller, 2012; Sommer et al., 2015). These conventional methods and practices are linear in nature, equipped for reactive rather than proactive NPD approaches. By strictly planning and explicitly setting the consumers' specifications and evaluation criteria up front (Antons et al., 2019; Cooper & Kleinschmidt, 2001; Kalluri & Kodali, 2014; Vinekar et al., 2006), these NPD methods bias and restrict the innovation space to the current market (whether mainstream or specific market segments). Only if the new product or concept complies and aligns with the up-front defined (current) consumers' demands, it will obtain a "go" decision and pass to the next "gate"; otherwise it will be discarded and considered a failure (Cooper & Kleinschmidt, 2001). This is clearly at the disadvantage of those options that

misalign with the "status quo", but which could proactively anticipate emerging and future demands. As a result, conventional NPD methods are "by design" more likely biased towards "me-too" innovations, often late and a step behind the dynamic and fast changing market (Lee & Xia, 2010; Serrador & Pinto, 2015).

While the literature has emphasized the importance of a consumer orientation (Busse & Siebert, 2018; Cooper, 2001, 2019; Horvat et al., 2019; Morgan et al., 2018; Ulrich, 2003; Urban & Hauser, 1993; Zhang & Xiao, 2020), it has also warned against the risk inherent in a complete, almost slave-like, dedication to (current) consumers' needs (Brege & Kindström, 2020; Narver et al., 2004). Despite this warning, conventional NPD methods and practices remain often anchored in alignments, leading companies to constantly strive towards a better fit with the current market (e.g. Cooper, 2001; Ulrich, 2003; Urban & Hauser, 1993), rather than to proactively explore the innovation potential of misalignments, as informative, beneficial and inspirational to the NPD process.

This becomes even more problematic in today's fast changing and sometimes unstable market (Khajeheian et al., 2018), where "agility", flexibility and change are required as never before (Cooper, 2008). Gate-stage methodologies have been accused of being too rigid, too linear and too planned to deal with such a dynamic market (Cooper & Sommer, 2016a) and incapable of strategically handling deviations that might emerge (Munthe et al., 2014). As a result, they may fall short of proactively supporting companies' learning opportunities and strategic options (Cooper, 2014; Sethi & Iqbal, 2008).

To overcome some of these shortcomings of the linear stage-gate methods and to better reflect the speed, dynamism and volatility of the current business environments, more agile methods have been advocated (Bianchi et al., 2020; Cooper & Sommer, 2016b; Lee & Xia, 2010; Recker et al., 2017). Agile methods, such as customer development and lean practices (Ghezzi & Cavallo, 2020), are characterized by higher levels of iteration, prototyping and product releases as part of a continuous leaning process (as opposed to linear up-front planning) (De Meyer et al., 2002). Moreover, agile methods support a strategic identification of changes and deviations that are proactively considered as valuable opportunities for the NPD process (rather than as failure or undesirable results) (Bianchi et al., 2020; Lee & Xia, 2010).

Although agile practices are widely documented in the digital industry (Beck et al., 2001; Boehm & Turner, 2003; Karlstrom & Runeson, 2005), they have not yet been thoroughly researched and adopted in other industries, such as in the physical product development, where their application is more challenging (Cooper, 2016). Cooper and Sommers (2016) highlighted properties of physical product innovation that prevent the one-to-one application of agile methods. Tangible physical products (e.g., a new beer, new polymer, new pharmaceutical) are not easily divisible into sub-components, not easily adaptable after release and not easily releasable into the market in short time, due to their dependence on adjustments in production facilities and machineries (Cooper, 2016; Cooper & Sommer, 2016b). Except for innovations that have marginal impact on the manufacturing and production process (such as a new colour of a car or a new flavour ingredient in a beer), a trial and error approach, with its constant experimentation and rapid product iteration and releases, is less feasible in the physical NPD (Cooper & Sommer, 2016b), as well as quite costly for mass production (although there might be more potential for customized physical product development, as in tailor-made fashion industry) (Goevert et al., 2018).

Therefore, with the aim of integrating characteristics of both stage gate and agile methods in a single approach, well equipped for the dynamism of the current market and applicable in a wider context, recent research has increasingly turned its attention on hybrid methods (Antons et al., 2019; Brock et al., 2020; Conforto & Amaral, 2016; Cooper & Sommer, 2016a; Salvato & Laplume, 2020; Sommer et al., 2015). As way of balancing between an highly structured process of clearly defined and sequential phases (stage gate) and an extremely iterative and agile approach, hybrid methods are rapidly gaining ground in the business world and hold potential to significantly change the way we think about new product development (Cooper & Sommer, 2016b). Despite this potential, academic research on hybrid methods for physical product development has been scarce. Specifically, further research is necessary to understand how some of the characteristics of the stage gate methods and of the agile approaches can be integrated to each other to develop new forms of hybrid methods, specific for the physical product innovation (Cooper & Sommer, 2016b).

Responding to this recent call for hybrid approaches in the context of physical product development, the aim of this chapter is to propose and validate a new method for the physical NPD process that is positioned as a hybrid approach. Our new method, that we call the *MUD method (misalignments users-designers)*, incorporates characteristics of both stage gate and agile approaches, such as the structured process, linearity, discipline and rigor of the former and the more proactive, iterative and leaning oriented perspective opened by the latter. These characteristics have been recognized as essential for future NPD methods and practices (Boehm & Turner, 2003) and for the current dynamic and rapidly evolving market (Cooper & Sommer, 2016a, 2016b; Sommer et al., 2015).

To fulfil this aim, the current chapter answers the following research questions: "*How could a hybrid method look like in the context of physical innovations*?", "*Analytically, how does this new method provide a deep insight into where and why (mis)alignments between companies decisions and consumers' demands might occur*? "*At strategic level, how does this new method provide tools to proactively manage (mis)alignments between companies and consumers, at the advantage of the innovation process*?"

In the next section, we discuss the literature dealing with the role of consumers in NPD (section 2.2.1) and present the theoretical foundations behind the conceptualization of our MUD method: the Goal determination theory (Ratneshwar et al., 2003) and the Means end chain theory (Olson & Reynolds, 2001; Reynolds & Gutman, 1988) (section 2.2.2). Afterwards, we discuss the existing NPD approaches from which the MUD method differs or draws inspiration (section 2.2.3 and 2.2.4). A description and visualization of our theory-based method follows (section 2.2.5). In the method section (section 2.3), we explain our qualitative data collection and we describe the context in which the MUD method has been validated: the European consortium, MYPACK, which involves leading food and packaging companies across Europe and aims at introducing a broad portfolio of packaging innovations.

2.2 Theoretical background

2.2.1. The role of consumers in the NPD process

Extensive NPD research has tried to pinpoint the factors that increase the success rate of product innovations (Cooper, 2019; Cooper & Kleinschmidt, 1987; Evanschitzky et al., 2012; Hauser et al., 2006; Henard & Szymanski, 2001). One of the key recognized factors is the integration of consumer inputs into the NPD process (Busse & Siebert, 2018; Cooper, 2019; Horvat et al., 2019; Morgan et al., 2018; Zhang & Xiao, 2020). Consumer inputs are considered valuable for various reasons: 1) for revealing unexplored and unfulfilled user needs that could represent innovation opportunities (Cooper, 2001; Ulrich, 2003; Urban & Hauser, 1993), 2) for identifying preliminary solutions to those needs that consumers might already have in mind (Von Hippel, 1986) and 3) for gaining new and valuable ideas already at early stages of the innovation process (Blank, 2020). Consumer inputs can be integrated into NPD activities to different degrees (Janssen & Dankbaar, 2008; Kaulio, 1998): from a more passive role in NPD, where consumers are asked to express their opinion on existing products, to becoming more active partners or co-innovators, who take lead in the idea generation or design selection (Fuchs & Schreier, 2011; Von Hippel, 1978). Consumer inputs into the NPD process has been advocated in several research traditions. Open innovation literature argues that a greater company opening towards external costumers and creative users can lead to new and promising ideas (Blohm et al., 2011; Cooper, 2019; Gassmann et al., 2006; Parmentier & Mangematin, 2014; Zhang & Xiao, 2020). Literature on front-end innovation and lean start-up emphasize the crucial role of consumers from the early stages of the NPD process (front-end) and even from the early stages of company's life (lean start-up) (Bortolini et al., 2018; Paternoster et al., 2014; Ries, 2011). Last, research on design thinking shows how thinking about consumers' needs benefits the overall design process, leading to superior ideas or products and facilitating innovation adoption (user-centred or human centric design thinking approach) (Brown, 2008; Chen & Venkatesh, 2013; Gruber et al., 2015; Veryzer & Borja de Mozota, 2005).

Although recognized as a crucial factor for the success of new products, the integration of consumer perspectives into NPD activities remains a challenging process (Grunert & van Trijp, 2014; Horvat et al., 2019), and how such integration should be implemented is still an ongoing debate. Research

into innovation management has, for example, started to question the conditions under which the involvement of consumers in the idea-generation process is beneficial (Poetz & Schreier, 2012) and which characteristics or skills consumers need to have to be really valuable to the NPD (Amabile, 1996; Füller et al., 2012).

Doubts remain among researchers and practitioners about the absolute value of such practice: researchers have argued that being overly dependent on consumer perspective can be undesirable, since consumers often do not know what they want, do not easily articulate their needs and desires, and express attitudes that are poor predictors of their behaviour (Klink & Athaide, 2006; Millett, 2006; Nijssen & Lieshout, 1995; Ulwick, 2002; Van Kleef et al., 2005). Furthermore, consumers often lack the imagination to envision innovative artefacts that fulfil their emerging needs (Goldenberg et al., 2003). Last, researchers have remarked on the challenges and controversies of an open and front-end innovation approach: excessive openness by companies might make them lose control of their innovation process (Gassmann et al., 2006; Lilien et al., 2002; Parmentier & Mangematin, 2014) and a strong focus on the consumer from the early stages might alienate designers from their core competences and restrict their creativity (Gassmann et al., 2006; Lilien et al., 2002). For the remainder of this chapter, we will refer to "designers" as those actors in the NPD process, who develop and market the innovation, including developers and marketers.

Concluding, the NPD process is best served by balance. Grounded in the "recognized relevance", the innovation process aims to integrate consumer prospective to create an "artefact" that is recognized by users for its relevance. This requires creative design focused on meaningfulness (appropriate and useful innovation to the target user) and distinctiveness (new products and differentiated from existing ones) (Amabile, 1983).

2.2.2 The "recognized relevance" from the perspective of designers and users

The Means end chain theory, and its practical implementation in the laddering technique (Olson & Reynolds, 2001; Reynolds & Gutman, 1988), provides a useful conceptualisation of the design process for "recognised relevance".

The Means end chain theory identifies how concrete features, developed during the design process, gain meaning and relevance for the desirable physiological and psychological consequences, called benefits, that product features are known or believed to signal (Gutman, 1982). These benefits, in turn, are instrumental to personal goals and values consumers want to achieve through the consumption or use of products. While consumer values are generally end states of being and concern the entire human existence (such as happiness or security) (Gutman, 1982), consumer goals are less abstract and more actionable, as they concern specific situations or actions (e.g., the goal of being healthy or relaxed) (Pieters et al., 1995).

The Means end chain theory follows a hierarchical structure (from concrete to abstract), which is typically considered in a bottom-up manner, representing the process of inference making from concrete physical features (*cues*) to higher-order beliefs of what the innovation offers, in terms of the *benefits* delivery and *goal* achievement (Olson & Reynolds, 2001). In other words, in perceiving and evaluating an innovative product, users follow a bottom-up abstraction process: from concrete cues of the new product with which they are confronted (e.g. biodegradable material), users *abstract* and infer relevance in terms of benefits (e.g., naturalness), which gain priority and additional meaning based on the goals that users want to fulfil through their choice (e.g., sustainability) (Brunsø et al., 2002; Steenkamp, 1990). The understanding of this *bottom-up abstraction process* with its cues-benefits-goals links is important, since it is the key determinant of users' acceptance of the innovation (Grunert, 2010).

The Goal determination theory (Ratneshwar et al., 2003) broadens this perspective beyond the bottom-up abstraction process, to also include a top down incorporation process that may be more representative for the designers' perspective. In their daily NPD practices, designers mainly follow a top-down incorporation process, since they *incorporate* and translate relevant goals that a new product needs to fulfil and that designers have in mind (e.g., convenience), into an offer of relevant benefits (e.g., easy to open packaging). These benefits are delivered through a set of concrete features in the physical product design (e.g., tear-off lid). The *incorporation process* is a *top-down* process, that starts from what an innovation should do for the user (the goals and benefits that the innovation should fulfil and offer), followed by the subsequent design of a concrete "artefact", a bundle of physical

product cues associated with relevant benefits and goals (Ratneshwar et al., 2003).

2.2.3 Identifying alignments and misalignments between users' and designers' perspectives: existing approaches

The conceptualization of the design phase of the NPD process, as a simultaneous top-down incorporation process (designer's perspective) and bottom-up abstraction process (users' perspective), provides an important analytical tool for the "recognized relevance". In developing new cues-benefits-goals combinations, the purpose is to align designers' and companies' NPD decisions with users' expectations (Costa & Jongen, 2006; Grunert & van Trijp, 2014). Conventional NPD methods assess this alignment through a linear gate-stage process, by evaluating whether the new product or concept fulfils consumer requirements, at each stage of the process (Cooper, 1990; Cooper & Kleinschmidt, 2001).

The stage-gate methodology follows a plan-driven rationale. The essence is that by setting criteria up front (Antons et al., 2019; Cooper & Kleinschmidt, 2001; Kalluri & Kodali, 2014; Vinekar et al., 2006) and screening whether these criteria have been met from early stages of the NPD process, through a series of checkpoints for a go or no go decision, large investments can be delayed and optimized towards the most promising products (Cooper, 1990, 2008; Cooper & Kleinschmidt, 2001).

As widely adopted among companies worldwide (Cooper & Kleinschmidt, 2001; Griffin, 1997b; Grönlund et al., 2010; Markham & Lee, 2013), traditional stage gate methods have been the subject of careful analysis, in terms of both advantages and shortcomings (Bers et al., 2014; Bianchi et al., 2020; Hutchins & Muller, 2012; Sommer et al., 2015). On the one hand, the structured process of clearly defined and sequential phases adds clarity and stability to the development process (Heirman & Clarysse, 2007). Moreover, discipline and rigor of the stage gate methodologies positively impact the NPD effectiveness (Mabert et al., 1992), the success in project execution (Tatikonda & Rosenthal, 2000) and the speed-to market (Griffin, 1997a). On the other hand, it has been noted that this same discipline and rigor, associated with a complete up-front planning, may leave insufficient room for deviations from the plan, constraining the innovation process to the early market predictions

which could already be (or soon become) obsolete (Bianchi et al., 2020; Lee & Xia, 2010; Serrador & Pinto, 2015).

While the traditional stage-gate methodologies help to understand *whether* the new idea/product aligns or deviates from current consumer preferences at each stage of the process, they are less informative on *why* such alignments or deviations exist and what innovation potential can be derived from it. Insight into where, how and why the designers' incorporation and users' abstraction processes are not fully aligned can be a creative source of innovation to build "recognized relevance" through meaningfulness (of benefits) and distinctiveness (of features). The hierarchical structure of the Means end chain approach, applied to the top-down and bottom-up process simultaneously, offers analytical insight into "the process in between"; into how cues, benefits and goals are connected and linked with each other and so into why alignments or deviations might emerge between company decisions and consumer demands (Olson & Reynolds, 2001).

2.2.4 Managing alignments and misalignments between users' and designers' perspectives: existing approaches

While the rigorous hierarchical structure of the means end chain approach provides a tool to systematically identify alignments and misalignments, offering an analytical insight and awareness, more flexible approaches have been advocated to manage such alignments and deviations, allowing for a more strategic insight (Beverland et al., 2015; Bianchi et al., 2020; Cooper & Sommer, 2016b; Lee & Xia, 2010; Recker et al., 2017).

Flexible methods, also referred to as "agile" or iterative methods, follow a learning-oriented rationale (De Meyer et al., 2002; Nakata, 2020). The principle is that, through iterative trial and error experiments, companies can quickly learn from their mistakes, gathering strategic insight for their NPD process (Bianchi et al., 2020; Nakata, 2020). This approach has proven to be particularly valuable in today's rapidly evolving scenario (Cooper & Sommer, 2016a; Lee & Xia, 2010; Smith, 2007), where speed, flexibility and change are increasingly required (Cooper, 2008). Agile methods support a proactive and strategic management of changes and deviations from the plan, that are embraced (rather than discarded) and framed as valuable learning opportunities (rather than as failures) (Bason & Austin, 2019;

Bianchi et al., 2020; Cousins, 2018; Lee & Xia, 2010; Nakata, 2020; Zheng, 2018).

By applying this agile and iterative approach to the NPD process, companies are confronted with the identified deviations and use them to re-consider constraints (Kolko, 2010; Leavy, 2010), to challenge what already exists (Nakata, 2020) and to produce new creative solutions (Carlgren et al., 2014). By misaligning with the "status quo", new options, that did not surface before, may emerge and new valuable discoveries may be generated (Nakata, 2020). This is evident in some radical innovations, such as Steve Job's mobile phone without a physical keyboard (iPhone) or the automobile of Henry Ford. Both these innovations originated from a deviation and misalignment with the current market (at that time), as Henry Ford is often claimed to have said "if I had asked people what they wanted, they would have told me faster horses". While a complete alignment among parties (between the designer and the user) would have limited change and creativity (Colville & Pye, 2010; Corsaro & Snehota, 2011), these misalignments opened up innovation opportunities and led to proactively explore emerging and future demands (Van Kleef et al., 2005).

2.2.5 Towards the creation of a new method for the NPD process: our proposed MUD method

Responding to the call for new hybrid methods for physical product innovations (Cooper & Sommer, 2016b) and synthetizing insights from existing NPD literature, we propose and validate a new theory based method for the NPD process, that is positioned as an hybrid approach. On the one hand, our MUD method integrates the discipline, rigor and linearity of the traditional stage-gate methods with the hierarchical structure of the means end chain approach to gain analytical insights. Analytical insights are derived from the analysis, comparison and identification of (mis)alignments between the designers' top-down incorporation and the users' bottom-up abstraction process. On the other hand, the MUD includes a proactive, reflection and learning-oriented perspective, typical of the agile methods, to gain a strategic insight; to strategically explore the identified misalignments between designers and users' perspectives.

The MUD method includes four stages: 1) designers' perspective, 2) users' perspective, 3) identification of (mis)alignments by comparing users and designers' perspectives, 4) a reflection meeting.

Stage I-designers' perspective: by integrating the rigor and discipline of the stage gate methods with the hierarchical structure of the means end chain approach, this first stage of the MUD method supports companies in the understanding of how their designers make decisions in their daily NPD activities. Building on the Goal determination theory (Ratneshwar et al., 2003) and going beyond the typical (bottom-up) applications of the Means end chain theory (Cooper, 2008; Olson & Reynolds, 2001; Reynolds & Gutman, 1988), we depict the designers' perspective as a *top down incorporation process* from abstract goals to benefits to more concrete cues (see stage I in *figure 2.1*). To operationalize this stage of the MUD method, data concerning how designers implement and incorporate goals and benefits into product cues during the NPD process are collected.

Stage II-users' perspective: this second stage of the MUD method supports companies in the understanding of how their users perceive and evaluate the developed innovation. Building on the Means end chain theory (Reynolds & Gutman, 1988), we analyse the users' perspective through the *bottom-up* cues–benefits–goals links of the *abstraction process* (see stage II in *figure 2.1*). To operationalize this stage, data regarding how users abstract and infer relevance in terms of benefits and goals from product cues are collected.

Stage III- identification of (mis)alignments by comparing perspectives: based on the idea that both users and designers connect goals through benefits to product cues in a hierarchical way, this stage of the MUD method compares the top-down incorporation with the bottom-up abstraction process. Specific (mis)alignments between users and designers' perspectives at different (hierarchical) level of the NPD process (at level of goals, benefits, cues and at their inter-related links) are identified. In comparing designers and users, the MUD comprises a rigorous and systematic approach, which draws inspiration from the rigor and discipline of the traditional linear NPD methods (stage gate). In identifying specific (mis)alignments between the cues–benefits–goals links for users and those for designers, the MUD method builds on the hierarchical perspective of the means end chain approach (Olson & Reynolds, 2001). Through this perspective, our proposed MUD

method 1) provides companies with an analytical insight and awareness of the existence of (mis)alignments between their designers and users and 2) reveals the specific level of the NPD process (goals–benefits–cues links) at which the designers and users start to misalign. To operationalize this stage of the MUD, the comparison and identification of misalignments are sequentially conducted at the goals, benefits and cues levels (*figure 2.1*):

- At the goals level, the comparison identifies whether users and designers have the same goals in mind and whether the goals that designers intend to offer with new product cues are recognised by users.
- At the benefits level, the comparison provides insights into whether the benefits that users want to receive are the same benefits that designers want to provide, and whether designers and users associate the same benefits with a common goal that they both share.
- At the cues level, the comparison enables the evaluation of whether the new product cues that are salient for users are the same cues that designers consider important to develop. Moreover, this comparison identifies whether the same goals and benefits for users and designers are associated with the same cues.

Stage IV- reflection meeting: by encouraging the internal communication, interaction and learning-oriented approach derived from the agile and iterative NPD methods (Chan & Thong, 2009; Lee & Xia, 2010), this stage supports companies in the proactive reflection and learning process on how to manage the identified misalignments. This stage of the MUD method is operationalized through a "reflection meeting" that comprises an awareness phase and reflection phase (see stage IV of *figure 2.1*). In the awareness phase, the specific company or community of designers are confronted with the identified misalignments and become aware of them. During the reflection phase, the company has the opportunity to reflect on 1) causes of the misalignments and factors that might have influenced them (why the misalignments are there and from what they arise), 2) implications that misalignments have for the company, 3) strategic solutions that companies might consciously and deliberately implement to fully explore the value of misalignments for the NPD process.

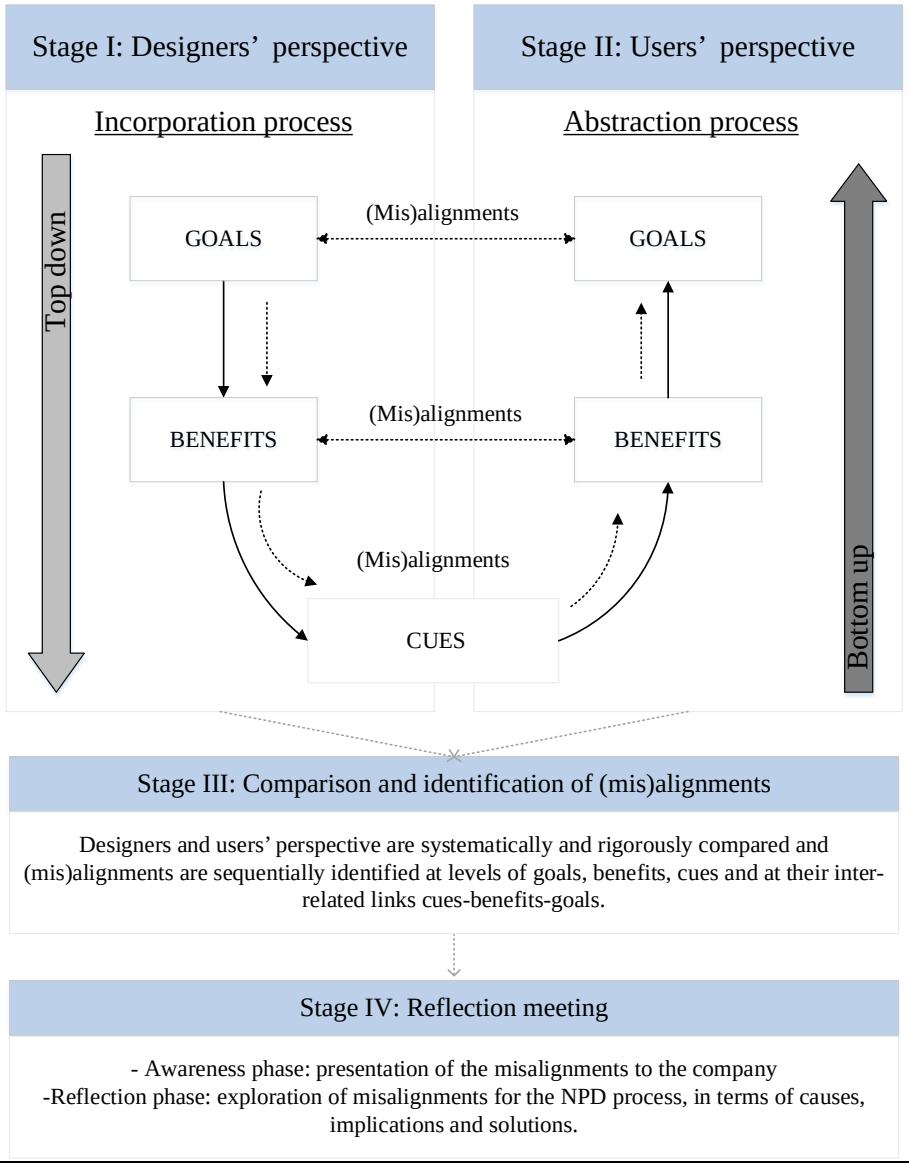

Figure 2.1: Our proposed MUD method for the NPD process to identify misalignments between users and designers and explore their innovation potential.

2.3 Research Method

In this section, we describe how the MUD method was validated. We first introduce the European MYPACK consortium and then we explain how each of the four stages of the MUD was validated and how the qualitative data collection was conducted.

2.3.1 Validation of the MUD method: context and stimuli

The MUD method, previously conceptualized, described and visualized (*figure 2.1*), was tested in the context of packaging innovations within the European consortium MYPACK. MYPACK is a consortium of packaging innovators, including developers and marketers, from innovative food and packaging companies across Europe. The aim of the MYPACK consortium, created in 2017, with the support of the European Union, is to identify and develop a portfolio of food packaging innovations targeting the sustainability of three distinct food product categories (baby food, fresh pre-cut salads, and organic biscuits). The diversity, in terms of countries (Germany, the Netherlands, Italy, France and Greece), disciplines and innovations that the consortium aims to develop, contributes to the realistic setting for testing and demonstrating the value of the proposed MUD method.

A large set of packaging innovations was selected to test the MUD, and specifically, to collect data on the top-down incorporation process of designers and on the bottom-up abstraction process of users (stage I and II of the method). The packaging innovations were selected in collaboration with MYPACK project and, most of them, were part of the portfolio of packaging innovations that the MYPACK consortium was developing between 2017 and 2021. The stimuli varied in terms of structural elements, such as packaging material, shape, opening/closing mechanism, level of transparency, micro-insertion technology applied to the packaging to extend food shelf life, and logos for biodegradable and compostable materials, but did not contain any other verbal or visual elements, labels or brands. For each of the three MYPACK product categories (baby food, fresh cut salads and organic biscuits), visual representations of between 15 and 19 packaging prototypes were developed by three graphic designers using 3D modelling.

The images were shown to respondents (designers and users) as printed A4-size images (examples of stimuli are shown in *figure 2.2*[1]).

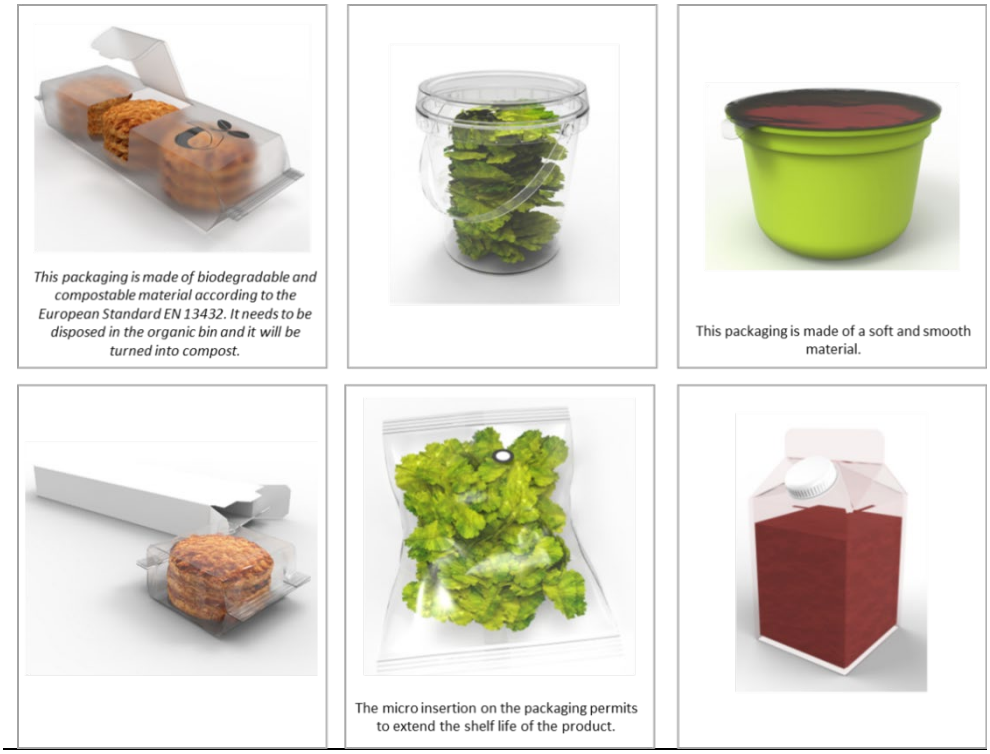

Figure 2.2: Examples of packaging innovations, which represented the stimuli of this research. Information below the image were reported when was necessary to clarify the innovation (e.g., explanation of logo, micro insertion technology etc..).

A qualitative data collection was conducted to test the MUD method: the first two stages of the method were validated through individual face to face interviews with packaging designers and packaging users. Stage IV of the method was validated through a focus group interview with packaging designers. The overall data collection took place between February and July 2019.

[1] The total set of stimuli is available from the author of this thesis.

2.3.2 Validation and data collection for stage I of the MUD method: interviews with packaging designers

To elicit the designers' top-down incorporation process, eleven designers (including developers and marketers) from Germany, France, Greece and Italy were recruited through the MYPACK project and interviewed through one-hour face-to-face in-depth interviews. More information on the recruited designers, including their function in the company, years of experience and background are provided in Appendix A (table A1), at the end of this chapter.

During the interview, designers were invited to reflect on their packaging design process by imagining that they would have to develop (or choose, if they were marketers) new packaging for a food product (either salad, baby food, or biscuits). Following the goals–benefits–cues links approach as the rationale of the top-down incorporation process of designers, the interviews were mainly top-down structured, guided by the following sequential topics: 1) which activities, goals and requirements designers take into account; 2) why they take these goals into account/which benefits they want to offer to consumers; and 3) which cues they would consequently develop/choose. After completing this task, packaging designers were shown a subset of the total stimulus set[2] and asked to indicate whether the proposed product–packaging combinations represented a product–packaging fit or misfit. As a final task, designers were asked "to step into the users' shoes" and indicate their beliefs about 1) which cues would be noted by the user, 2) which benefits were offered by the cues, 3) which goals were served by those benefits and cues, and 4) which opinion they would expect users to have about the packaging innovations.

[2] The designers were confronted with the product category relevant to them. Five designers were confronted with packaging innovations associated with a biscuit product, four designers with packaging innovations for baby food, and two with packaging innovations for salad.

2.3.3 Validation and data collection for stage II of the MUD method: interviews with packaging users

To elicit the users' bottom-up abstraction process, thirty users of the proposed packaged products (baby food, salad and biscuits) were interviewed through individual one-hour face-to-face in-depth interviews3. The respondents were recruited in the Netherlands through a professional agency and compensated for their participation with a €20 voucher.

The interviews used the *salient cue elicitation* (Kelly, 1955) and *laddering* techniques (Steenkamp & Van Trijp, 1997). First, respondents were shown a set of three stimuli (12 triads in total) in a random order and asked to indicate how two of the stimuli were alike and different from the third, until they could not notice any more differences/similarities in each set of stimuli. The respondents had to specify which of the end-poles of elicited cues they liked best. These questions were repeated for all 12 triads of stimuli. The elicited cues (salient cues) formed the inputs for the laddering procedure in which, using structured "why" questions, implicit knowledge is retrieved about the benefits and ultimate goals that consumers (un)consciously associate with the cues. At the end of the interview, users were shown a full set of product–packaging combinations and were asked to indicate the ones representing a product–packaging fit.

2.3.4 Analysis of the interviews

The interviews with packaging designers and users were recorded, transcribed verbatim and subjected to a content analysis. All perceptions of packaging cues and inferences in terms of benefits and goals were identified and coded as either: (a) cue, (b) cue immediate perception, (c) direct benefit, (d) indirect benefit or (e) goal (adjusted from Gutman, 1982)[4].

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[3] Ten users were interviewed about the packaging innovations for baby food, ten with biscuits and ten with salad. The recruited users had to be the regular consumers of the product in question (buying the packaged product at least once every two weeks).

[4] The codes "*cue*" and "*cue immediate perception*" represent the packaging cues (concrete and abstract) that the users recognized as salient from the stimuli and that the designers stated they developed for a certain product. The codes "*direct benefit*" and "*indirect benefit*" represent benefits that users inferred from the cues and that the innovators wanted to offer to users. The code "goal" represents the goals that users perceived as being served or hindered and that designers had in mind when developing packaging for a specific product.

The analysis of the interviews with users was consolidated in *hierarchical value maps* that represented the bottom-up abstraction process of users. This comprised: the cues salient to users, the goals and benefits retrieved from the packaging cues, and the links between cues, benefits and goals. A cut-off value of five was used to graphically represent the cues–benefits–goals links in the hierarchical value maps[5] (similar to the methods used by Barrena & Sanchez, 2010; Nguyen et al., 2012).

The analysis of the interviews with the designers was consolidated in *goal implementation maps* that represented the top-down incorporation process of designers. This included: the goals that designers stated to have in mind, the benefits that they wanted to communicate, the physical cues they would design and the links between them. These links are the focus of the comparison between the designers and users' perspectives (rather than the goals, benefits and cues *per se*). Three hierarchical value maps and three goal implementation maps resulted from the analysis of the interviews (one for each product category). The maps of each product were comparable in terms of their coding and hierarchical structures.

The data related on the product–packaging fit as perceived by the designers and users were analysed using a frequency analysis. If fewer than 50% of users and designers evaluated the proposed packaging innovation as an example of fit, it was categorized as a misfit[6].

2.3.5 Validation of stage III of the Mud method: systematic comparison and identification of misalignments between designers and users

Designers and users' perspectives (stage I and II) were compared in three steps. First, they were compared through the measures of product–packaging (mis)fit, which provided insights into how well designers and users are aligned in their overall assessment of product–packaging (perceived) appropriateness. The perspectives were next compared through the confrontation of the hierarchical value map with goal implementation

[5] If a certain link between a cue and benefit or benefit and goal was mentioned five times or more, it was considered relevant to many users and was graphically displayed in the hierarchical value maps. This was done to make the maps interpretable.

[6] The detailed protocols of the interview procedure and additional information on the data analysis plan are available from the corresponding author.

map for each product category for a general indication of alignments and misalignments at different hierarchical and inferential levels, especially at the goals level (top of the maps) and cues level (bottom of the maps). Finally, the perspectives were compared through the confrontation of specific ladders extrapolated from the hierarchical value maps and goal implementation maps, to provide detailed insights into misalignments between designers and users for the goals–benefits and benefits–cues links (middle part of the maps).

2.3.6 Validation and data collection of stage IV of the MUD method: reflection meeting with designers

The final step in the procedure (stage IV) consisted of a reflection meeting where the misalignments, identified by comparing hierarchical value maps and goal implementation maps, were presented to and discussed with the designers. Twelve packaging designers took part in the reflection meeting, designed as a focus group interview, which was moderated by the first author and facilitated by the second author of this chapter. Designers from Italy, France, Greece and the Netherlands, including developers and marketers from food and packaging companies, were recruited from MYPACK. Four of them also participated in stage I. More details on the designers' recruitment are available in Appendix A (table A1). During the reflection meeting, the designers were first asked to think of possible reasons why general misalignments occur between designers and users, then they were presented with the identified misalignments to reflect on their possible causes, implications and solutions. The meeting was audio-recorded, transcribed verbatim and analysed using coding and content analysis.

2.4 Results

The results of the stage I (designers' perspective) and stage II (users' perspective) of the MUD method were compared (stage III) to reveal 1) the alignments and misalignments between designers and users' overall assessments of product–packaging (perceived) fit, and 2) specific misalignments at the hierarchical and inferential levels of the cues–benefits–goals links.

2.4.1 Alignments and misalignments between designers and users' overall assessment of product–packaging perceived fit (stage III)

Perceptions of the product–packaging fit provide a first indication of the alignments and misalignments between designers and users. For one third of the proposed packaging innovations, the designers and users had a different perception of product–packaging fit and were thus misaligned with each other (white areas in *figure 2.3*).

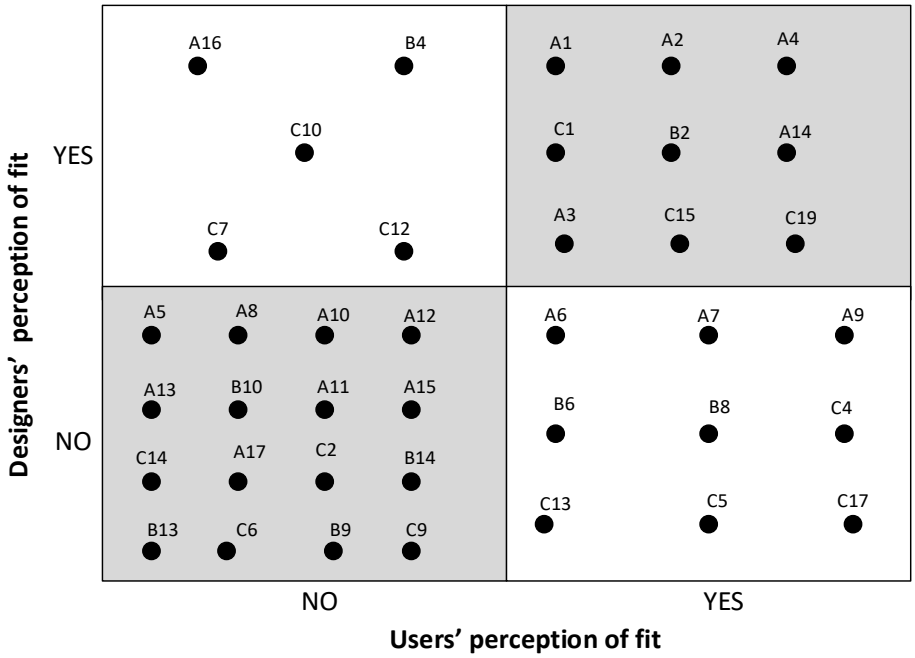

Figure 2.3: Alignments and misalignments in the perception of product-packaging fit (yes/no) between designers and users. Numbers and letters on the dots represent the name of the stimuli: A (n=17) refers to packaging associated with baby food, B (n=15) refers to packaging associated with salad, and C (n=19) refers to packaging associated with biscuits. The position of the dots in the quadrants is randomly assigned. The quadrants contain only those product–packaging combinations that were evaluated by both designers and users (where the comparison was possible).

2.4.2 Alignments and misalignments at the hierarchical and inferential levels of the cues–benefits–goals links between users and designers (stage III)

The confrontation of the goal implementation map (top-down structure derived in stage I) and the hierarchical value map (bottom-up structure in stage II) gives a first indication of the alignments and misalignments at different hierarchical and inferential levels, especially at the goals level (top of the maps) and cues level (bottom of the maps). Looking first at the goals level, the example presented in *figure 2.4* (for the case of biscuits) shows that designers and users have a certain level of overlap, such as for the overarching goals of convenience, attraction, preservation and sustainability. Designers and users also have a certain degree of misalignment, since certain goals are relevant only for designers (e.g., coherence, inform, differentiate) or users (e.g., sharing). At the cues level, designers and users align on certain cues, such as for single units, glass, metal, and paper, and misalign on other cues mentioned only by designers or users.

The comparison between the hierarchical value map and goal implementation map for the product categories of salad and baby food are provided in Appendix B (figures B1 and B2) at the end of this chapter.

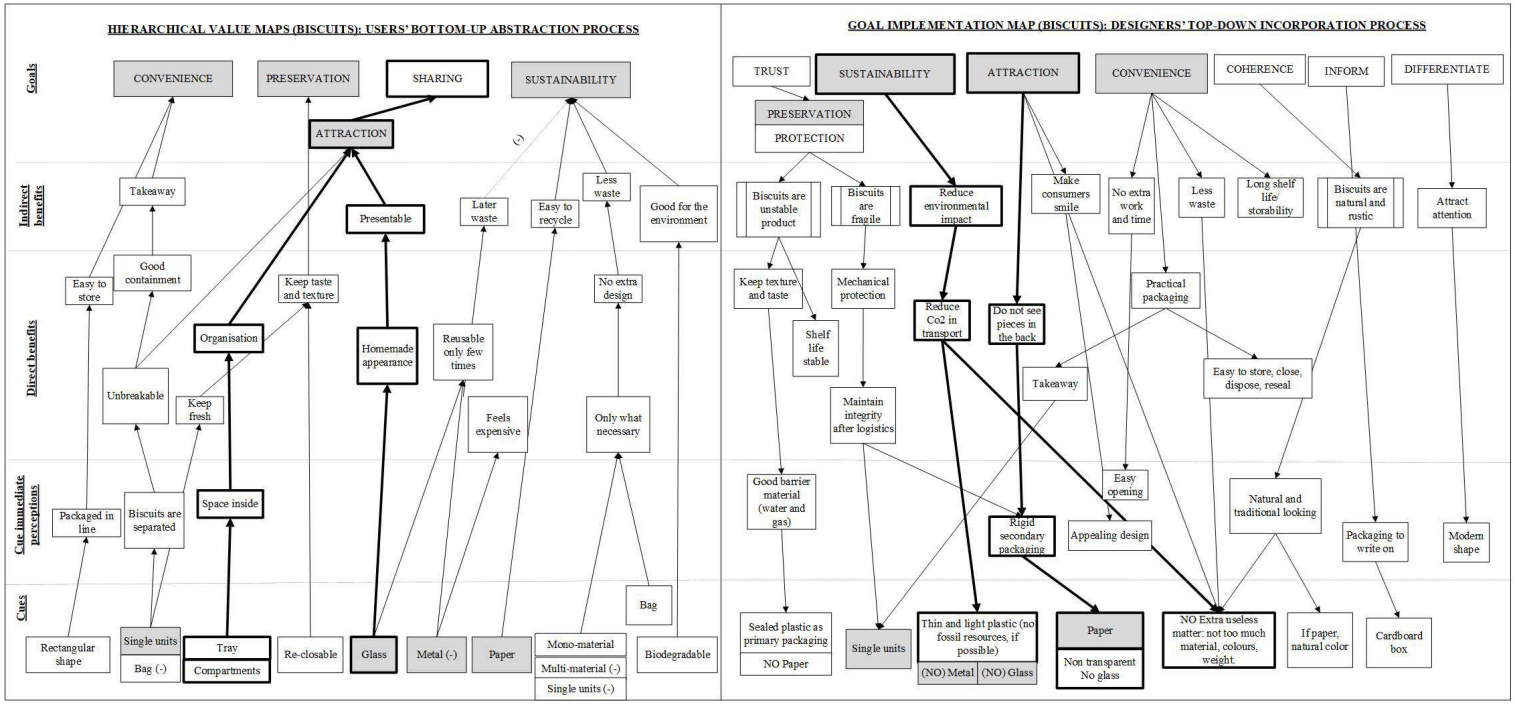

Figure 2.4: Comparison of the hierarchical value map and goal implementation map for biscuits to illustrate the goals, benefits and cues relevant for users and designers and the links between them. Boxes in grey at the goals and cues levels represent the goals and cues that designers and users have in common (cases of alignment), while those in white indicate misalignments.

As one of the added values of the MUD method lies in exploring misalignments, we focus on cases where designers and users misalign (white areas in *figure 2.3*). The identification of a misalignment between users and designers at a specific level of the NPD might explain why the same packaging innovation was perceived differently by designers and users in terms of fit/misfit. The packaging of biscuits in a tray (C4 in f*igure 2.3*), for example, represented a good example of product–packaging fit for users, but a bad fit for designers, as one of them stated:" Not *a good fit as [there] is too much plastic, even if it is bioplastic. You can make it half as heavy and provide the same protection. There is also lot of space between the biscuit stacks and too much material. Not a fit with these plain biscuits*". Another designer stated, "*Too much packaging; consumers would not like it*".

In this case, designers and users have different goals in mind: designers evaluate the innovation based on the goal of *sustainability*, while users do so based on the goal of *sharing*, not mentioned by any of the designers (marketers and developers) and indeed not included in the goal implementation map (*figure 2.4*). The hierarchical value map (for biscuits) shows that users positively perceive the *tray shape* of the proposed packaging innovation, since it *creates space inside the packaging* for the content and makes the packaging *organized*. Such *organization* is an indicator of *quality and attraction* for users and is related to the goal of *sharing* the product (life moments of sharing with family, visitors and friends) (*figure 2.5*).

By comparing the hierarchical value map with the goal implementation map (and specifically by considering specific ladders), the MUD method shows that designers and users do not recognize each other's important goals (in this case, sustainability vs. sharing), which might explain their disagreements in the perception and evaluation of the same innovation.

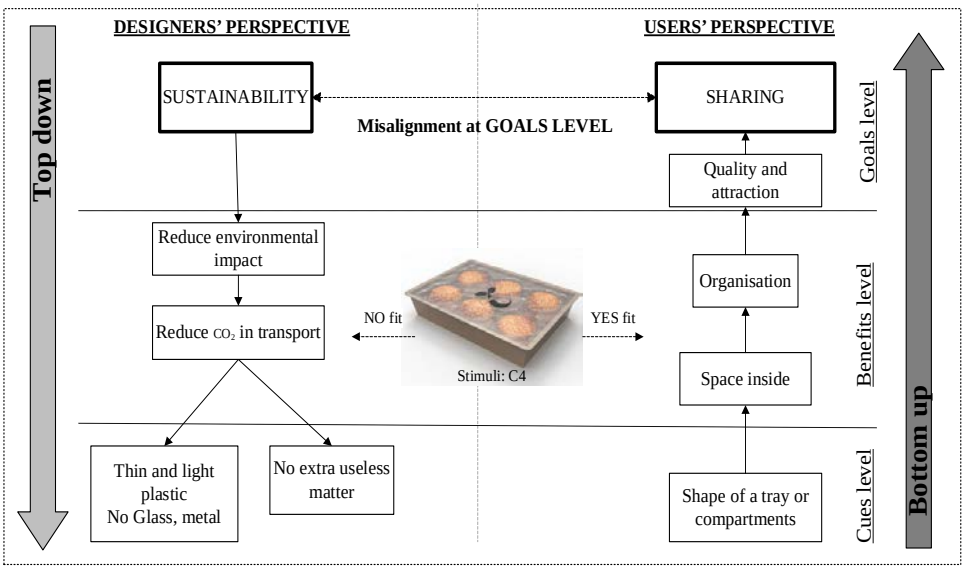

Figure 2.4: Comparison of a ladder extrapolated from the goal implementation map for biscuits and one extrapolated from the hierarchical value maps for biscuits to illustrate an example of misalignment at the goals level, which might explain why designers and users differently perceive the same packaging innovation (C4).

Placing the focus of the comparison on the centre of the ladders (middle part of the maps) allows us to study how benefits are linked to goals and cues, and to what extent these connections are aligned between designers and users. The comparison revealed that even when designers and users have the same goal in mind, they link this goal to different benefits (goal–benefit link). *Figure 2.6* shows an example of misalignments at the benefits level, which might explain the different perceptions of designers and users of the same proposed biscuit packaging innovation. Glass packaging (C17 in *figure 2.3*), for example, was perceived by users as a good example of product–packaging fit, but a bad fit for designers: "*...Through transparent glass you can see little pieces of product that break off, which is not nice to see. In addition, the biscuits will leave a shadow on the glass and it will look dirty"*, one designer stated.

"*I think that consumers would believe that the shelf life is not good because it looks homemade, not a safe commercial product*", another designer said. For the same reasons why designers evaluated this packaging as a bad fit with the product (the packaging is transparent and looks homemade), users evaluated it as a good fit.

Although both designers and users had the same goal in mind (attraction and aesthetic appeal), they associated it with different benefits, which led to completely different and contradictory perceptions and evaluations of the same packaging cues. Specifically, users associated *attraction* (goal) with *homemade looking* and *presentable packaging* (benefits), and, in turn, they positively evaluated the *transparent design* of the *glass packaging* (cues) (*figure 2.6*). On the contrary, designers associated *attraction* with a *non-transparent packaging*, which prevents people from observing dislodged pieces of product in the back of the packaging. Moreover, contrary to the users, designers negatively evaluated the *homemade looking* aspect of the packaging, which they felt would harm the consumers' perception of the safety and shelf life of the product.

By comparing how goals are linked to benefits for designers and users, the MUD method enabled us to reveal that, although designers intend to target the same goals that users want to fulfil, in this case they offered benefits that differed from the ones users want to receive with the innovation. Consequently, designers might develop innovation cues (rigid secondary packaging, non-transparent, non-glass) that are not accurately recognized by the users or adequately designed based on user inputs.

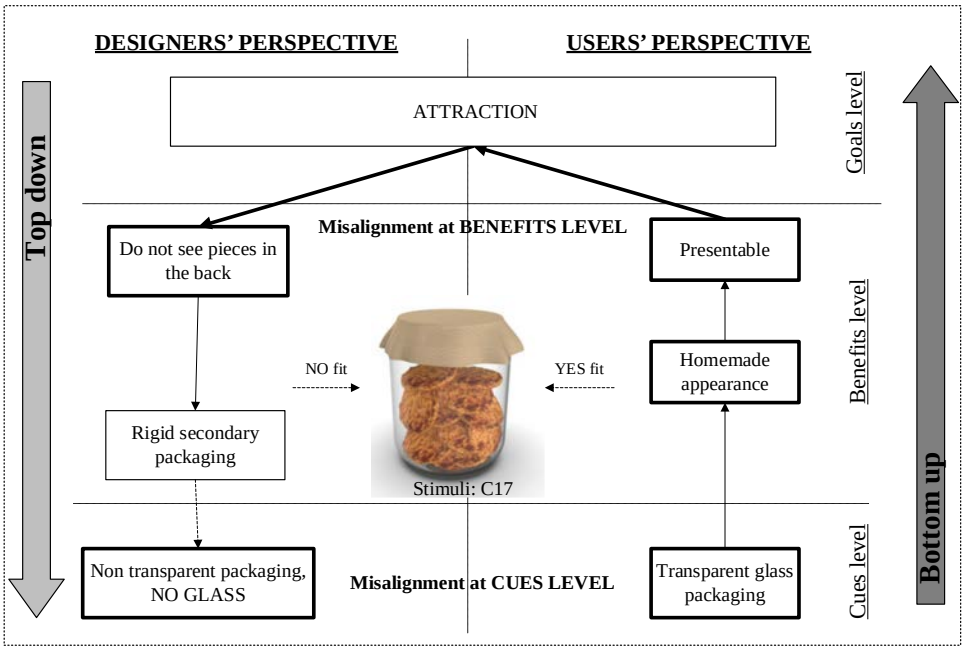

Figure 2.5: Comparison of a ladder extrapolated from the goal implementation map for biscuits and one extrapolated from the hierarchical value maps for biscuits to illustrate an example of misalignment at the benefits and cues levels, which might explain why designers and users differently perceive the same packaging innovation (C17).

By focusing on how goals and benefits are linked to cues (goals/benefits–cues links), the MUD method revealed the cases in which the same goals for users and designers were translated into different cues. *Figure 2.7* shows an example of misalignment at the cues level, which might explain why the same packaging innovations are perceived and evaluated differently by users and designers. The box shape packaging for fresh cut salad (B8 and B6 in *figure 2.3*), for example, was perceived as a good example of product–packaging fit by users, but a bad fit by designers: "*This sector requires bags, not trays or boxes. If you travel to twenty countries and go to the supermarket, concerning the product of salad you will realize that eight out of ten solutions are bags"*, one designer stated.

Therefore, in this case, the different perception of product–packaging fit between users and designers is attributable to a different way of conveying the same goal (convenience and freshness) into packaging cues: users associate freshness and convenience with *rigid box shape packaging*, while, to convey the same goal (*convenience and freshness*), designers develop a *flexible bag shape packaging* (for the product of salad) (*figure 2.7*). This finding also suggests that designers carefully design freshness into technical aspects (bag shape packaging made of light film, with good breathability properties) that users do not recognize.

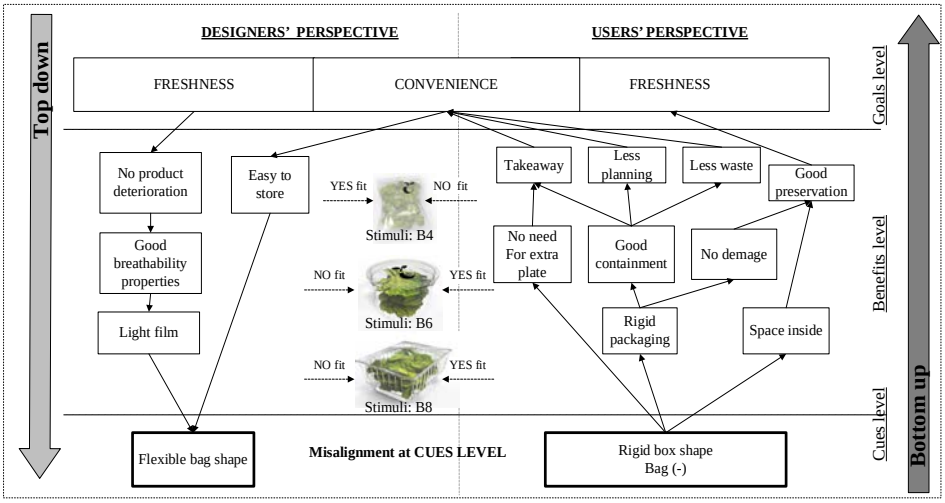

Figure 2.6: Comparison of a ladder extrapolated from the goal implementation map for salad and one extrapolated from the hierarchical value maps for salad to illustrate an example of misalignment at the cues level, which might explain why designers and users differently perceive the same packaging innovations (B8, B6, B4).

2.4.3 Learning from misalignments: the reflection meeting (stage IV)

During the reflection meeting, designers explored the misalignments by reflecting on their causes, implications and solutions. Three main solutions that might be implemented to exploit the value of misalignments for NPD were voiced during the meeting: 1) reduction of the misalignment and restoration of an alignment, where the misalignment represents a barrier to market success; 2) maintenance of the misalignment where it is essential for the product functioning; or 3) maintenance of the misalignment and its further exploration where it might open new market opportunities.

The solution to reduce a misalignment was, for example, discussed in relation to a misalignment identified at the goals level (case of biscuits), where users and designers did not recognize each other's goals: designers were unaware of the relevant user goal of sharing (users evaluate the packaging based on its social and sharing aspect), while users did not recognize the designers' efforts to convey sustainability through the packaging cues. Confronted with this misalignment, designers first reflected on the possible causes that might have influenced this misalignment and on its implications for NPD. One of the possible causes that emerged from the discussion centred on the idea that designers and users have different ways of thinking: designers considered themselves objective and rational, in contrast to the emotional consumer: "*The average consumer often has inputs at the emotional level*", a designer stated. "*Experts and industries are objective. Our answers are generally recognized. Our process and procedure are documented, and when we take a decision, it has enough scientific evidence of being a good one. In contrast, consumers have subjective knowledge; what they think is not documented and so they raise objections*", another designer said. This might explain why designers, who, in their rational behaviour, give priority to the sustainability of the packaging, do not value the emotional, social and sharing aspects of the packaging (goal of sharing) as users do. If they are not aware of the users' goals, designers might risk missing marketing opportunities and fail to incorporate (in this case) emotional, social and sharing aspects into packaging cues that users may value. Moreover, this misalignment may indicate that sustainability is not as salient to users as it is for designers, so users might not recognize innovation efforts and creativity deliberately implemented in the product design.

Considering the causes and implications of this misalignment, designers reflected on the necessity of reducing it, either by making consumers "more rational" or themselves becoming "more emotional" (as the designers intended this terminology). The designers perceived difficulties in adjusting to the users' more emotional perspectives: "*Consumers need to become more rational. For us experts, it is much more difficult the other way around [for experts to change]; we cannot become more emotional with what we do*". To make consumers more rational, designers reflected on the necessity of educating consumers and communicating in a more transparent and homogenous way. The sustainability aspect of the packaging could indeed become more salient and visible to consumers if, as one designer proposed, "*we create a unique*

logo, recognized across Europe, which is modern and minimal, and which should reflect the environmental parameters of the film instead of having different logos for different countries [as now]".

The solution of maintaining certain misalignments was also voiced, where misalignments might be natural and essential for the product functioning, such as in the case of packaging aspects salient to designers but less so for users (e.g., the breathability of the packaging that prevents product deterioration, or long shelf lives). Designers discussed the different potential causes of these misalignments: 1) consumers have limited knowledge and lack a comprehensive view of the entire supply chain and its requirements (e.g., safety and freshness requirements), as one designer stated: "*Consumers do not know the constraints, the logistics, what happened before. For the customers, the story of the packaging only starts when the product is bought*". 2) The designers have been trained to make certain aspects of the packaging invisible to consumers: "*We are trained to design a packaging in such a way that consumers do not even notice it. I was trained for four years to make packaging so easy to open that you don't even notice*". 3) The designers and packaging experts have some prejudices towards consumers, which influence how they communicate technical aspects (e.g., safety): "*It is generally agreed that consumers will not understand complex things and are considered to be not very intelligent. Members of the packaging industries think that it is not possible to engage deeply in complex communication with consumers*".

Important implications were noted by designers in relation to the identified misalignment: safety and shelf-life requirements are probably considered a bare minimum by consumers; they can lead to product rejection if they are absent but are not noticed if present. If the company opts for restoring an alignment with consumers, lower investments in the baseline requirements (shelf life, breathable material, safety and freshness requirements) would likely create a product not accepted by consumers. In this case, it is advisable to maintain such a misalignment, since it is essential for proper product functioning and considered natural by the designers: "*These differences [between designers and users] are natural. We just need to understand that this difference exists. Why should we imagine that this bridge will be crossed?*". Aware of this misalignment and of its implications, the company might opt for an alternative communication with consumers, which would make certain requirements more visible and salient to consumers: "*Consumers think that if*

you extend the shelf life of the product [to make it safer for longer] you do something (strange) to the product", therefore "*We, experts, should start telling a story that consumers can see and not the one we have in our minds*". In this case, designers started to "step into their users' shoes", indicating an opening and learning process.

The solution of maintaining and further exploring a misalignment was proposed in relation to misalignments that might open innovation opportunities, such as in the case of the misalignment identified at the cue level, where designers develop cues (bag shape packaging for salad) not always in line with consumers' demands (box shape packaging). The designers identified three main reasons that might explain the existence of this misalignment: 1) Designers' daily practices are not sufficiently consumer oriented: "*We in companies feel that we are very consumer driven but maybe we are not [consumer driven] enough. We are price driven. We immediately discard the consumers' requirements that are too expensive or that we consider to be too expensive*". 2) There are gaps within the companies between the development and marketing phase "*Marketers and developers are often not aligned; the same question can be answered in two different ways between technology and marketing, and I think that can create mismatches*". 3) Designers' intentions and creativity are constrained by different boundaries, such as the scale of production needed to be innovative: "*Generally the big companies like Danone or Nestle can express specifications and everybody follows them. Apart from these big companies, there is no possibility [for others] to ask for big innovations in packaging*".

Maintaining and further exploring this misalignment (the one identified at cue level) might be advisable and beneficial for the company, since it might open to new design opportunities. For example, by providing salad in rigid box shape packaging, making it easier to take away and eat on the go, companies could go beyond the mainstream market of salad in the typical bag packaging.

Table 2.1 summarizes the main results of the reflection meeting in terms of causes, implications and solutions that designers mentioned for the misalignments identified.

Table 2.1: Causes, implications and solutions for the misalignments discussed during the reflection meeting to help the company extract the deepest value of misalignments for the NPD process.

Causes of misalignments	Implications for the company	Solutions
Different way of thinking between designers and users: rational vs. emotional	Barrier to market success Missed market opportunities	Repair an alignment: by making consumers more rational (role of communication), or designers more emotional
Consumers lack a comprehensive view of the supply chain Education and training of designers Prejudices by designers	Natural misalignments, essential for product functioning	Maintain the misalignment but be aware
Lack of consumer-oriented approach Innovation requirements/boundaries Gap marketing-developers	Market/innovation potential	Maintenance and further exploration of misalignments

2.5 Discussion and research implications

This chapter had three main research ambitions: 1) to propose and test a new hybrid method for the physical product innovation, in response to a recent call in this regard (Cooper & Sommer, 2016b), 2) to increase company analytical insight into the NPD process 3) to offer a strategic approach in exploring the value of misalignments. These ambitions were realized by conceptualizing and testing the MUD method. The application of the MUD method has provided a pivotal analytical insight into users and designers' perspectives and into how, where and why differences exist between users and designers' perception of the same innovation. This was achieved by integrating the discipline, rigor and linearity of the stage gate methods with

the hierarchical structure of the means end chain perspective. In addition, moving beyond the reactiveness of the traditional stage gate approaches, the MUD method integrates a more proactive, iterative, reflection and learning oriented perspective, typical of the agile methods, to gain an additional strategic insight. The MUD encourages designers to reflect together on misalignments, not from the perspective of "failure" but rather as business potential. During the reflection meeting, designers went through all the identified misalignments as a check list and reflected on their causes, implications for the NPD process, as well as on how to strategically handle each of them: they reflected on the necessity of reducing the misalignments in cases where they represented a barrier to market success or missed marketing opportunities, to maintain them when they were essential for the product functioning, and to further explore them when they might represent innovation opportunities. Through this process of internal communication and interaction, derived from the agile approaches, the MUD method has proven to be a useful learning tool, even in a packaging context, which tends to be a highly technology, rather than consumer, driven domain. The stage IV of MUD method allowed packaging designers to detach from their more conservative perspective, opening towards a more progressive and consumer-oriented approach, closer to design thinking.

2.5.1 Theoretical and managerial implications

The current research has several theoretical and managerial implications. First, this chapter adds to the nascent and growing research on agile-stage-gate hybrid methods in the context of physical product innovation (Cooper & Sommer, 2016b). This research opens new possibilities of balancing between a highly structured process of clearly defined and sequential phases (stage gate) and an extremely iterative and pure agile approach. Improving the traditional stage gate approaches, enriched with agile components to better fit the dynamism of the current market, the MUD method offers an original contribution to both NPD approaches (stage gate and agile) for physical product development.

Second, at a theoretical level, our focus on the diversity that exists between the perspective of designers (as top down incorporation) and users (as bottom up abstraction) and on the opportunities that misalignments open for the NPD process, substantially contributes to the existing NPD research,

that, until now, has been biased towards alignments, as the key to market success (e.g., Cooper, 2001; Ulrich, 2003; Urban & Hauser, 1993).

Third, this research identifies a new domain for the Means end chain theory (Olson & Reynolds, 2001; Reynolds & Gutman, 1988) and the Goal determination theory (Ratneshwar et al., 2003), namely that of the hybrid methods for the NPD process. These theories have proven useful to simultaneously look at top-down incorporation process and bottom-up abstraction process "as two sides of the same NPD coin". This chapter advances the understanding of designers' daily practices in the NPD process, that would not have been possible without going beyond the typical application of the means end chain approach and, thus, applying an alternative way (top-down) of looking at the cues–benefits–goals links.

At the managerial level, this research enriches the "NPD toolbox" with a new method that can be combined with other NPD methods. One could, for example, imagine the application of MUD within the design thinking approach (DT) to structure and detail the coherence between the first four stages of DT: empathize, define, ideate and prototype (Dam & Siang, 2018; Plattner, 2016). The "goal level" of the MUD method, in which designers aim to align with consumers' goals relates to the "empathise" stage of the design thinking approach. The "benefits level" of the MUD structures the "define stage" of the DT, where products benefits are defined and need to be translated into a bundle of product cues in the "cues level" of the MUD and in the "ideate and prototype phase" of the DT. The MUD method can contribute to the DT as it does not only compare designers and users' perspectives at these levels but also provides a tool to connect these levels, ensuring consistency in the design process.

Using the realistic setting of the large European packaging consortium MYPACK, this research offers a robust and validated method that is ready to use. Moreover, by identifying specific misalignments at the levels of goals, benefits and cues, the MUD method provided companies with specific insights (e.g., at which goal–benefit link designers and users start to disagree), which are informative and useful for the implementation of precise and relevant strategies on how to handle the misalignments.

While the identified misalignments and the insights that can be obtained from them are specific to, in our case, packaging innovations, and may differ

from company to company, the method procedure is general and applicable to different contexts, both within and beyond the packaging field.

2.6. Limitations and avenues for further research

As a first study on the new MUD method, there are limitations to be mentioned and several avenues for further research can be identified. First, the MUD method shares some of the limitations of the means end chain and laddering methodologies: these assume the existence of a hierarchical cognitive structure in consumers' mind, retrieved through the laddering interviews (Cohen & Warlop, 1995). It might be that such hierarchical structure is an artifact of the data collection technique used, which might "push" respondents to create, instead of retrieve, hierarchically linked concepts up to abstract values (Cohen & Warlop, 1995; Van Rekom & Wierenga, 2007). To mitigate this potential effect, we terminated the laddering procedure at the level of users' goals (rather than continuing up to the abstract values associated to these goals).

Second, we envisage broader applications for the MUD method in other contexts beyond packaging (such as in the car industry, holidays, robotics, fashion, design, software etc..), but some adjustments might be necessary. For many fast-moving consumer goods, terminating ladders at the goal level may suffice. Instead, for those companies developing products that express consumer identity, values and life principles, the MUD method (stage I and II) might need to be extended to capture and retrieve cognitive linkages up to values.

Third, the long procedure and intensive data collection of the MUD method might represent a practical limitation in those industries (such as software industry) that base their NPD process on a trial-and-error approach, with fast iteration and testing. In order to make the MUD method more suitable in such industries, and in general more manageable and less labour intensive for its practical application, companies could decide to delegate the interview procedure to a marketing research agency or reduce the sample size by interviewing only certain relevant members of the company (instead of designers from different departments, countries and backgrounds [marketers and developers], as we did) or only their habitual consumers or lead users. In turn, the analysis procedure would be simplified and would flow into more concise maps, increasing the "agility" of the overall method.

Furthermore, the MUD method is mainly intended for the experimental phases of the NPD process, such as concept testing, prototyping, product testing, design, which are timely moments to identify misalignments between users and designers so they can still be used as valuable insights. The MUD method is indeed a "pre-market" method, particularly relevant once a product idea has reached specification as a bundle of features. We expect its contribution to the NPD process to be less evident with existing products, as a "post-market" approach.

While the MUD method explored the innovation potential of misalignments in terms of analytical insights (increased companies' awareness) and strategic insights (as a reflection and learning tool), the consolidation of this innovation potential in actual innovations remained beyond the scope of this research. Further studies need to be conducted to investigate the effect of hybrid methods (such as ours) on company performance.

Last, while the method was primarily developed to investigate designers and users' perceptions (through their cues–benefits–goals links), it rather overlooks their preferences and choices. By investigating users and designers' perceptions rather than preferences, which change faster and require larger samples to be assessed, our method was developed to rely on a modest sample size, as was used in this research.

Despite these limitations, the MUD method supports companies in the identification of possible misalignments between designers and users of innovations and suggests how the awareness of these misalignments can be strategically used for the product development process.

2.7 Acknowledgements

The authors of this research thank the packaging designers who volunteered for stage I and stage IV data collection, and the consumers who participated in stage II. The authors also thank the graphic designers Sem Lootsma, Tom Feij and Sven Deinum for the creation of the 3D images used in this research.

2.8 Appendices

Appendix A: Designers recruited

Appendix B: Designers and users' perspective- salad and baby food

Appendix A: Designers recruited

Table A1: Information on the designers recruited for the validation of stage I and IV of the MUD methods

Designers	Companies where the designers are working in	Background of the designer	Current function of the designer	Years of experience in that function	Recruited to validate which stage of the MUD method
Designer #1	French company developing food and packaging innovations	Technical-food engineer	Technological innovation director and R&D manager	10 years	Stage I (face to face individual interview) and stage IV (focus group interview)
Designer #2	French company developing food and packaging innovations	Technical-packaging engineer	Packaging engineer in R&D	4 years	Stage I (face to face individual interview)
Designer #3	French company developing food and packaging innovations	Marketing	Marketing manager	10 years	Stage I (face to face individual interview)
Designer #4	French company developing food and packaging innovations	In marketing and R&D	Sensory panel	18 years	Stage I (face to face individual interview)
Designer #5	German company developing food and packaging innovations	Technical-food and packaging scientist	Food scientist	8 years	Stage I (face to face individual interview)
Designer #6	German company developing food and packaging innovations	Marketing and business economics	Marketing manager	23 years	Stage I (face to face individual interview)
Designer #7	Greek company developing food and packaging innovations	Technical-packaging engineer and analytical chemistry	R&D manager	20 years	Stage I (face to face individual interview) and stage IV (focus group interview)
Designer #8	Greek company developing food and packaging innovations	Marketing	Marketing director and deputy CEO	12 years	Stage I (face to face individual interview)
Designer #10	Italian company developing packaging materials	Technical-environment science and agriculture	Agricultural Public Affairs specialist	5 years	Stage I (face to face individual interview) and stage IV (focus group interview)

Designer #10	Italian company developing packaging materials	Technical-materials' engineer	Technical and development team	12 years	Stage I (face to face individual interview)
Designer #11	French technical centre developing packaging	Technical-materials' engineer	Packaging expert	20 years	Stage I (face to face individual interview) and stage IV (focus group interview)
Designer #12	Dutch institute of sustainable packaging	Packaging design and development	Packaging expert	2 years	Stage IV (focus group interview)
Designer #13	Dutch institute of sustainable packaging	Packaging design and development	Packaging expert	8 years	Stage IV (focus group interview)
Designer #14	Italian company on environmental (packaging) assessment	Marketing and communication, eco-design	CEO of the company	9 years	Stage IV (focus group interview)
Designer #15	Greek company developing food and packaging innovations	Technical- food and packaging engineer	Packaging expert	9 years	Stage IV (focus group interview)
Designer #16	Italian company developing packaging materials	Material engineer	R&D packaging researcher	6 years	Stage IV (focus group interview)
Designer #17	French company developing food and packaging innovations	Packaging engineer	Senior packaging engineer and innovation coordinator	20 years	Stage IV (focus group interview)
Designer #18	French packaging institute	Technical-packaging engineer	R&D manager	5 years	Stage IV (focus group interview)
Designer #19	Italian research and innovation company	Food engineer	Food and packaging expert and CEO	7 years	Stage IV (focus group interview)

Appendix B: Designers and users' perspective- salad and baby food

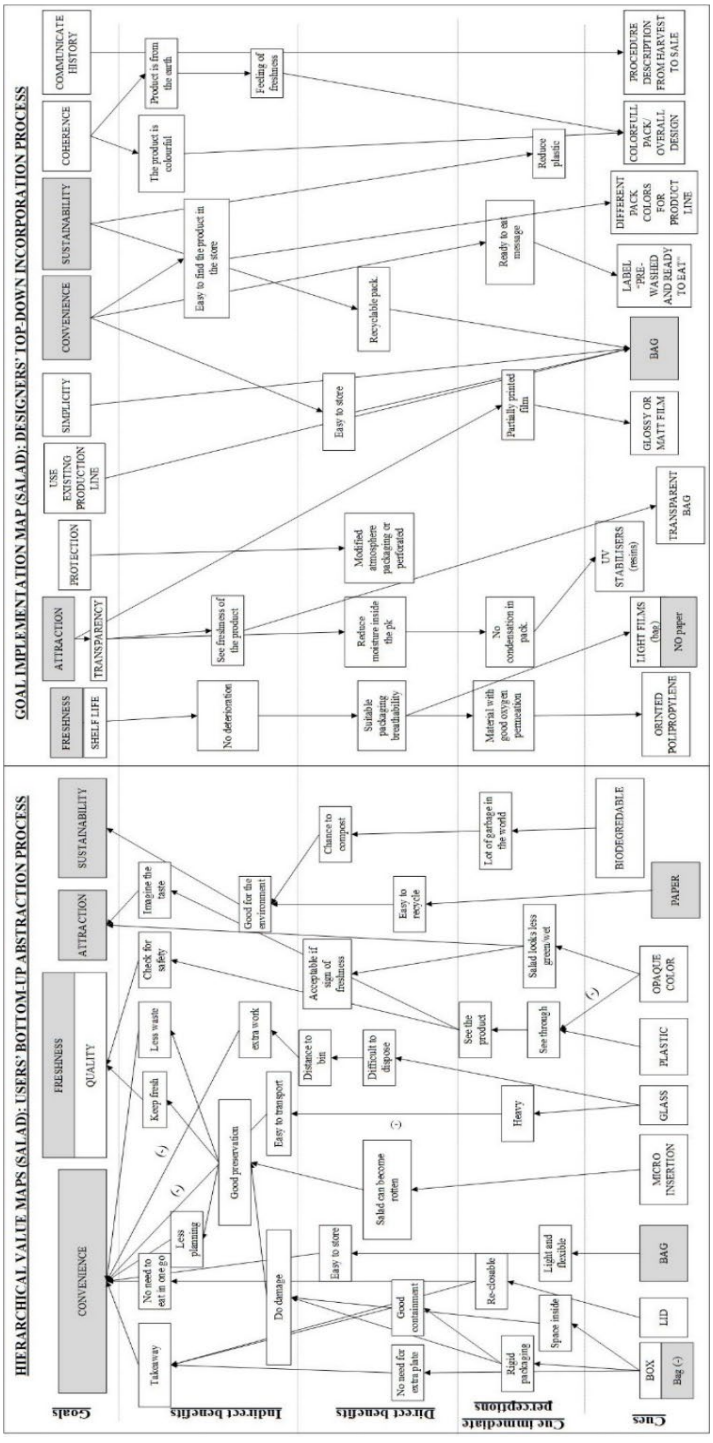

Figure B1: Comparison of the hierarchical value map and goal implementation map for salad to illustrate the goals, benefits and cues relevant for users and designers and the links between them. Boxes in grey at the goals and cues levels represent the goals and cues that designers and users have in common (cases of alignment), while those in white indicate misalignments.

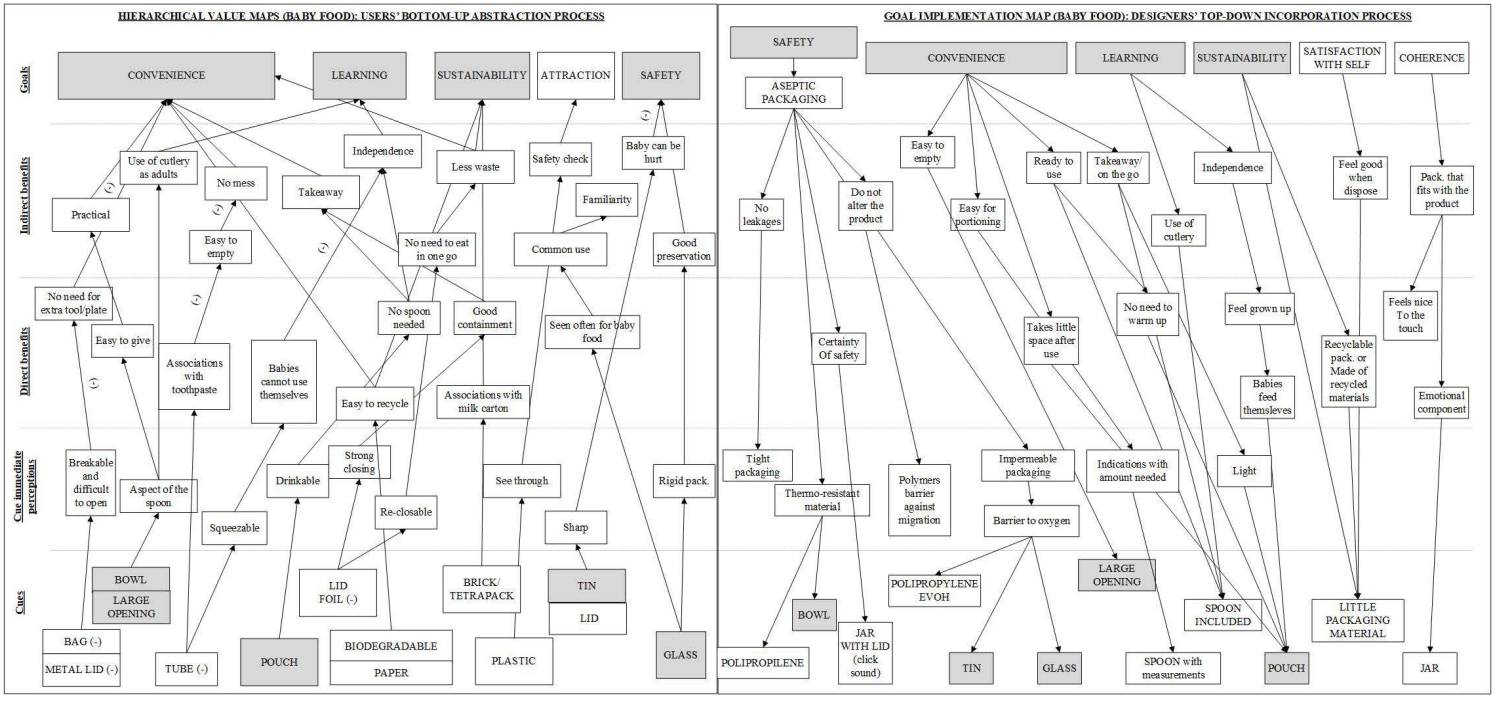

Figure B2: Comparison of the hierarchical value map and goal implementation map for baby food to illustrate the goals, benefits and cues relevant for users and designers and the links between them. Boxes in grey at the goals and cues levels represent the goals and cues that designers and users have in common (cases of alignment), while those in white indicate misalignments.

3

Chapter III

The price of sustainability: how consumers trade-off conventional packaging benefits against sustainability.

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Abstract

Sustainable food packaging alternatives represent an ever-expanding trend on supermarkets' shelves. Despite the technological efforts, a higher sustainability level often comes at the expense of other (perceived) benefits which consumers might not want to sacrifice. While the balance between the benefits and drawbacks of a "cleaner" packaging production is central to the designers' perspective, it is generally overlooked in consumer research. This chapter investigates how European consumers cope with product-packaging decisions, when these involve a compromise. Through an online survey with 5035 consumers in five different European countries, our results show that the sustainability appreciation can spill-over to other conventional benefits, such convenience, aesthetic quality or the perceived ability of the packaging to preserve the content. By contributing to sustainability literature and, in particular, to the understanding of the halo and spill-over effect of sustainability, this study shows that positive associations triggered by eco-design elements (e.g., a biodegradable and compostable material) absorb and filter out negative experiences, preventing consumers from perceiving certain drawbacks. This research also provides valuable practical implications to marketers and product designers, by demonstrating how different product categories, packaging types and consumer characteristics, in terms of gender, age, nationality, values and lifestyle, influence product-packaging decisions and their inherent trade-offs.

Key words: sustainable packaging, trade-off, biodegradable and compostable packaging, paper packaging, path model.

3.1 Introduction

The entire food system, from production to consumption, including sourcing, processing, transport and packaging, contribute to one third of the total greenhouse gas emissions, responsible for global warming and to the general environmental crisis (Crippa et al., 2021). It is important to note that the environmental footprint of the food product is way larger than the environmental footprint of the packaging (Crippa et al., 2021; Silvenius et al., 2014). However, the global concerns about plastic pollution (with micro and nano-plastics) are of such a magnitude, that they rightly highlight the question of how we can improve the sustainability of packaging (Bruijnes et al., 2020). Packaging has become a key player in the green revolution of food industries, increasingly committed to changing their products, processes or organizational structures towards a more sustainable development (Allied market research, 2016). Various companies, such as McDonald's, Unilever, Nestle, Kraft-Heinz, PepsiCo and Coca-Cola have started to target packaging sustainability in their action plans, through the launch of new materials (e.g., biodegradable, recycled) or new designs that allow a reduced amount of material (lighter packaging with less plastic) (Boz et al., 2020; Guillard et al., 2018; Olsen et al., 2014).

The Sustainable Packaging Coalition (a packaging industry collaborative) defines sustainable packaging as a *packaging that is sourced responsibly, designed to be effective and safe throughout its life cycle, meets market criteria for performance and cost, is made entirely using renewable energy, and once used, is recycled efficiently to provide a valuable resource for subsequent generations* (SPC, 2011). This definition, that integrates both environmental and economic considerations, reminds that packaging is more than "just a container". In long supply chains, packaging has a crucial contribution to product loss prevention and waste reduction, whose environmental impact would be far greater without the packaging (Bruijnes et al., 2020). This implies a careful balance between packaging environmental efficiency and packaging functionality. For the successful introduction of more sustainable packaging, designers aim to increase the environmental efficiency without compromising on functionality (e.g., in terms of preservation, protection or communication) (Boz et al., 2020; De Koeijer et al., 2017; Luchs et al., 2012).

Next to being important from a design perspective, this balance between the different packaging functions is also relevant in the consumer perspective,

in the perceptual and evaluation process. More sustainable packaging designs may lead to (un)intended changes in consumer perception, evaluation and purchase intention of packaged products, both in a positive and negative direction (Steenis, 2019). For example, as the concept of sustainability is cognitively associated with other benefits (Luchs et al., 2010), a sustainable packaging appearance can lead consumers to perceive a higher product quality or naturalness (Magnier et al., 2016). At the same time, sustainable packaging can also be associated with potential sacrifices, such as in terms of perceived aesthetic quality. For example, biodegradable and compostable materials tend to be cloudier and opaquer than conventional plastic, whose transparency is associated with an attractive, fresh and trustworthy product (Billeter et al., 2012; Guillard et al., 2018; Simmonds & Spence, 2017; Sirviö et al., 2013; ten Klooster, 2008). This change in appearance, due to a change in material type for environmental reasons, may confront consumers with a trade-off, where aesthetic quality must be compromised for a (potentially) greater material sustainability.

Taken together, these examples imply that the "price of sustainability" can be either objective or only perceived. On the one hand (at the objective level), it is important to note that sustainable packaging innovations, at the present stage, often present objective drawbacks, despite the technological efforts aimed at finding "the optimal" solution. A higher sustainability level often comes at the expense of other benefits that consumers might not want to sacrifice (e.g., aesthetic quality). On the other hand (at the subjective level), the drawbacks may not be objective, but only perceived. Still, it is important to investigate how consumers trade-off and compromise between the perceived benefits and sacrifices, as this ultimately affects consumers' intention to purchase sustainable alternatives.

While this balance between the benefits and drawbacks from a "cleaner" packaging production is central to the designers' perspective, it is generally overlooked in consumer research. Prior research has largely studied consumer acceptance of sustainable packaging with a focus on the enhanced sustainability level (Herbes et al., 2018; Ketelsen et al., 2020; Lindh et al., 2016b; Steenis et al., 2018) but hardly from the perspective of a benefits-drawbacks trade-off. As a result, the research focus often lies on the sustainability benefit per se (Granato et al., 2022; Magnier & Schoormans, 2015) and not in relation to other competing benefits in the choice set.

As sustainability is only one of the many criteria in consumer decision-making, a perspective that integrates both benefits and drawbacks contributes to a more realistic and fuller understanding of consumer acceptability level of sustainable technologies.

This research investigates consumer response to sustainably packaged products, integrating such a trade-off perspective. It centres around the research question: "*How, in their packaged product choices, do consumers trade-off and compromise between packaging sustainability and other relevant benefits in the choice set, as convenience, preservation or aesthetic quality*?". In addition, acknowledging that contextual factors, such as consumer characteristics or product categories, might influence the way in which consumers cope with product-packaging decisions and their inherent trade-offs, this research replies to a second research question: "*How do packaging design cues, benefits' perceptions and consumers' characteristics relate and interact in affecting consumers' purchase intention for sustainable product-packaging alternatives*?".

In order to answer these questions, the current research builds on the theoretical model of object-subject interaction, which relies on consumer subjective perception and evaluation processing of objective design elements (Brunswick, 1952; Olson, 1978; Steenkamp, 1990). In the next section, the theoretical concepts are discussed and a framework is proposed.

3.2 Theoretical background and framework

The way in which consumers respond to sustainable product-packaging design, including how they trade-off and compromise between available alternatives, can be seen as the result of two sequential psychological processes: 1) *a cue perception stage*, in which consumers utilize the physical features (i.e., cues) of the packaging design to infer product-packaging benefits (cues-benefits relations) (Grunert, 2005; Grunert & van Trijp, 2014; Olsen et al., 2014; Steenkamp, 1990; Zeithaml, 1988) and 2) *a cue evaluation stage*, in which consumers evaluate and trade off the perceived benefits to ultimately respond in terms of attitudes (evaluative judgements), purchase intention and choices (benefits-intention relations) (Ajzen, 1991; Brunswik, 1955; Fazio, 2007). How consumers deal with the trade-off depends on the relative importance they assign to the perceived benefits that in turn depends on contextual factors and consumer characteristics (Basili &

Chateauneuf, 2011; Edwards, 1954; Kahneman & Tversky, 1979; Tversky & Kahneman, 1992; Von Neumann & Morgenstern, 1947).

3.2.1 Cue perception stage: cues-benefits relations

Packaging design cues are the result of a design and production process focused on three main goals and functions, namely to "protect and preserve", "communicate" and "facilitate handling and ease of use" (Lindh et al., 2016b). With the growing concern about environmental issues, sustainability has become an additional decision criterion in packaging design, setting new challenges and initiating changes in the structural packaging cues. Such cues, like the *material type*, *format*, *opening/closure mechanism* and *transparency* refer directly to the physical features of the packaging and are the primary focus of packaging developers to convey specific consumer benefits, as a certain degree of sustainability, convenience, preservation or aesthetic quality (Magnier & Crié, 2015; Rettie & Brewer, 2000; Steenis et al., 2017). An important characteristic of structural cues is that they are "implicit" in nature, as they influence consumer response through an inferential belief formation process, and they require interpretation from consumer side. Based on previously encountered associations and prior knowledge (Olson, 1978; Steenkamp, 1990), consumers might, for example, rely on an opaque (non-see through) biodegradable packaging to infer a greater sustainability or a lower aesthetic quality.

In "re-designing" structural cues for improved product-packaging sustainability (i.e. eco-design), packaging developers can work on two frontiers, 1) on the packaging through the use of more environmentally friendly materials (e.g., biodegradable, recycled, recyclable, paper materials to replace conventional plastics) (Granato et al., 2022b; Lindh et al., 2016b; Magnier & Schoormans, 2015) or through material reduction (e.g., flexible and lightweight bags to replace rigid formats) (Ojha et al., 2015), and 2) on the packaged product, allowing a more efficient product use and reduction of waste. For example, a format that allows completely emptying packages of liquid products or a mono portion or re-closable packaging can reduce food spoilage and waste (Verghese et al., 2015; Williams et al., 2012).

As sustainability is not the only criterion in consumer decision making, a key design challenge lies in balancing the structural design cues so that these,

next to having a reduced environmental impact, also positively contribute to (or at least do not jeopardize) the primary packaging functions, recognized by consumers as the benefits of preservation and protection ("protect and preserve"), convenience ("facilitate handling and ease of use") and attraction or aesthetic quality ("communicate") (Granato et al., 2022b; Lindh et al., 2016b).

The balance between sustainability and other functional benefits (as protection, preservation, communication) is particularly relevant from a consumer marketing perspective, as perceptions of these benefits are often interlinked. For example, changes in the packaging material for environmental reasons (e.g. biodegradable and compostable) may have unavoidable consequences for the perceived appearance of the packaging (bio materials tend to be more opaque than conventional plastics) (Steenis, 2019). This may affect consumer perceptions and evaluations of the aesthetic quality (benefit of attraction) and even its perceived ability to properly preserve the content (benefit of preservation) (Billeter et al., 2012; Granato at al., 2022b; Lin & Chang, 2012; Pancer et al., 2017; Simmonds & Spence, 2017). Moreover, although they might be more sustainable, packages with a reduced amount of material, such as a lightweight flexible foil instead of a rigid lid, are perceived as less convenient, since they are non-re-closable and less practical for on-the-go consumption (Granato et al., 2022b). Therefore, the process of "re-designing" for an improved product-packaging sustainability may lead to perceived changes in other benefits besides sustainability (Lin & Chang, 2012; Luchs et al., 2010).

These considerations imply that it is important to consider and anticipate all the relations that structural packaging cues have with benefit perceptions (cues-benefits relations) and how these ultimately affect consumers' intention to purchase sustainable alternatives.

3.2.2 Cue evaluation stage: benefits-intention relations

When competing and mutually exclusive features co-exist in the choice set, consumers make a trade off and compromise (Da Silveira & Slack, 2001; Johnson, 1974). New sustainable technologies often imply a real and/or perceived trade-off between functionality and sustainability (Lin & Chang, 2012; Luchs et al., 2010).

How this trade-off is resolved depends on the subjective importance that consumers attach to each of the competing benefits (Basili & Chateauneuf, 2011; Edwards, 1954; Kahneman & Tversky, 1979; Tversky & Kahneman, 1992; Von Neumann & Morgenstern, 1947). This subjective importance is highly linked to individual differences (Bettman et al., 1998) which influences consumer decision-making at a more proximal or distal level. At a more distal level, consumer socio demographic and socio-economic characteristics, like country, gender, age, education or income, have been recognized to indirectly influence sustainable food behaviour (Dolnicar et al., 2018; Fischer & Frewer, 2008; Grebitus et al., 2015; Hansen et al., 2018; McFadden & Huffman, 2017; Paul & Rana, 2012). These characteristics exert their influence through more intermediary or proximal determinants (Ajzen, 1991; Carvajal et al., 2004). For example, people's age (distal factor) can affect their values (intermediary factor), goals and lifestyle (more proximal factors) that, in turn, influence which benefits consumers find important and desirable (Bettman et al., 1998).

Consumer values, defined as the life guiding principles in people's lives (Schwartz, 1992) might explain and predict consumer trade-off involving sustainability (De Groot & Steg, 2009; Poortinga et al., 2004; Steg et al., 2014). Consumers who strongly endorse self-transcendent values, such as universalism and benevolence are more likely to act pro environmentally compared to individuals who endorse self-enhancement values (Nordlund & Garvill, 2003; Stern, 2000; Thøgersen & Ölander, 2002). While values are abstract principles, consumer goals are more proximal and context-specific determinants (Steg et al., 2014). In the food domain, for example, consumer food related lifestyle (Grunert et al., 1993), like consumer sensitivity to prices or convenience, their willingness to search for information or the degree to which they enjoy shopping, reflect consumer goals in a specific context, directly influencing food shopping behaviour.

Existing research has focused on several of these consumer characteristics to explain acceptability level in the context of sustainable packaging (Martinho et al., 2015; Prakash & Pathak, 2017; Van Birgelen et al., 2009). Nevertheless, these characteristics have not yet been integrated in a comprehensive model. In addition, it remains unclear how these consumer characteristics influence the relationships between packaging design cues, benefit perceptions and consumer intentions.

To fill this knowledge gap in how packaging design cues and benefit perceptions relate and interact in affecting consumer purchase intention for the sustainable product-packaging alternative, this research 1) integrates a benefits-drawbacks trade-off perspective, and 2) validates these relationships across different contextual factors, as consumer characteristics of age, gender, nationality, lifestyle and values and product categories.

3.2.3 Theoretical framework: cue perception and cue evaluation in the consumer response to sustainable product-packaging alternatives

The theoretical framework combining the different theoretical concepts is displayed in *figure 3.1*. Based on the concept of "object-subject interaction" (Brunswick, 1952; Olson, 1978; Steenkamp, 1990), this framework integrates insights from the theoretical models related to cue perception (e.g., Olson, 1978; Steenkamp, 1990) and cue evaluation process (e.g., Ajzen, 1991; Brunswik, 1955; Fazio, 2007). The way in which consumers respond to sustainable product-packaging alternatives (and express a purchase intention) is modelled as the result of a two-step process, a cue perception and a cue evaluation process.

Applied to the context of sustainable product-packaging combinations, this framework is first used to explore which benefits the packaging is perceived to signal through its physical design cues (cues-benefits relations) (Grunert, 2005; Grunert & van Trijp, 2014; Steenkamp, 1990; Zeithaml, 1988). As primary attention is on the process of re-designing towards an improved sustainability, this framework focuses on a series of structural cues, namely the *material type*, *format*, *opening/closure mechanism* and *transparency/opacity level* (Steenis et al., 2017). These cues indirectly affect consumers' intention to purchase the sustainable packaging alternative, through the four benefits' perceptions of *sustainability, convenience, preservation & protection and attraction* (Magnier & Crié, 2015; Rettie & Brewer, 2000; Steenis et al., 2017). Moreover, this framework is used to investigate how consumers trade-off the perceived benefits and how they cope with (product-packaging) decisions when these involve inherent benefits-drawbacks trade-off (benefits-intention relations). Thus, the second part of the framework, the cue-evaluation stage, regards the subjective importance consumers assign to the perceived benefits (Brunswick, 1952; Lancaster, 1966).

This research first tests the overall model, and specifically, the cues-benefits-intention relations. As the existence of these relations have been largely confirmed in prior research (Ajzen, 1991; Brunswik, 1952; 1955; Fazio, 2007; Olson, 1978; Steenkamp, 1990; Steenis, 20017), our focus will not be on reconfirming the existence of each individual relation, but on exploring differences in these relations in the context of sustainable product-packaging combinations. After having tested the overall model, this research validates it across different contextual factors, as product categories and consumer characteristics.

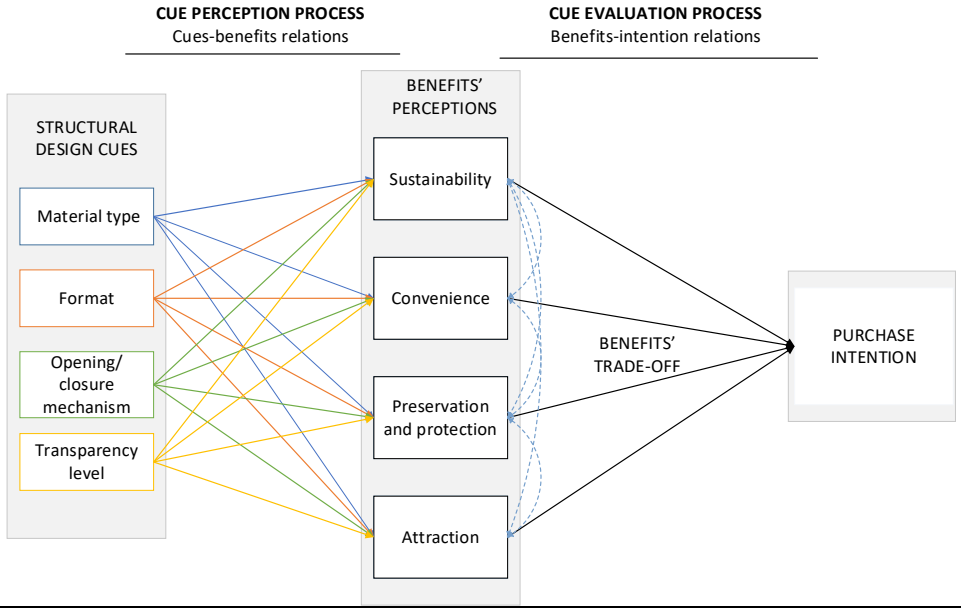


Figure 3.1: Theoretical framework of consumer response to sustainable product-packaging alternatives.

3.3 Methods

3.3.1 The MYPACK project as context for validation

The proposed framework (*figure 3.1*) was tested in the context of product-packaging innovations within the European consortium MYPACK[7], that includes food and packaging companies and research institutes across Europe. The aim of the MYPACK consortium, created in 2017 with the

[7] www.mypackfood.eu

support of the European Union, is to develop and commercialize a portfolio of sustainable food packaging innovations for three distinct food product categories: biscuits, baby food, and fresh salad. Within the portfolio of sustainable food packaging innovations, MYPACK has worked to develop and optimize, among others, biodegradable & compostable materials, recycled materials, paper packaging and blow device technologies (extending shelf life). The research in this chapter tests two material-type design efforts towards an improved packaging sustainability, namely biodegradable & compostable packaging and paper packaging. These technologies were chosen in agreement with packaging experts of MYPACK, including companies performing Life Cycle Assessment analysis (LCA) as highly promising in the sustainable packaging design process.

The diversity, in terms of countries in which the MYPACK project operates (Germany, the Netherlands, Italy, France, Greece), product categories involved (biscuits, baby food, salad) and packaging innovations (biomaterials, paper alternatives etc.) informed the design of this research, contributing to the realistic and diversified setting for testing and validating the proposed framework.

3.3.2 Sample and procedure

A total of 5035 participants from the five MYPACK European countries (Germany, the Netherlands, Italy, France, Greece) participated in the study, based on quota sampling on gender, age and educational level. Participants were screened on the use of the three MYPACK product categories (baby food or fresh salad or biscuits) in each country. Data were collected in October/November 2019. Participants were sampled from the panels of a market research agency (GfK) and invited to participate in the survey by email for which the recruitment agency (GfK) ensured appropriate translations into local language after consultation with native speakers. Respondents were asked to provide socio-demographic/economic characteristics (e.g., gender, age) before they were confronted with the stimulus material and answered questions measuring their purchase intention, benefits' perceptions, their values, and food related lifestyle.

Six versions of the survey were created, varying in 1) the packaging material for the sustainability benefit (biodegradable/compostable and paper) and 2) the product category (biscuits, baby food, fresh salad). Participants were

assigned to one of these six versions and engaged in a survey with a cyclic design.

3.3.3 Stimuli

Product-packaging combinations were designed as stimulus material, varying in the structural cues of material type, format, opening mechanism, transparency level (part of our framework, *figure 3.1*). No labels or brands were included to make sure respondents would focus only on the structural elements. For each of the three MYPACK product categories, visual representations of product-packaging prototypes were developed using 3D modelling by a graphic designer, in collaboration with MYPACK project. Stimuli were presented to respondents including a brief description and series of definitions, formulated with the MYPACK packaging experts (*figure 3.2*).

To mimic the shopping contexts in which consumers evaluate products in comparison to others (rather than in isolation), this study adopts a cyclic design to generate systematic pairs of product-packaging combinations. As characteristic to cyclic designs (David, 1988; Spence & Domoney, 1974), pairs were selected to ensure that in each pair one option scored high or low on the four benefits of sustainability, convenience, preservation & protection and attraction and was the opposite of the other one[8]. This would result in 8 pairs. To ensure all pairs reflected an informative benefits' trade-off, a fractional factorial cyclic design was adopted such that the (trivial) pair comparing a product scoring high on all four benefits with a product scoring low on all four was omitted (*table 3.1*).

The resulting 7 pairs of product-packaging combinations were shown to each respondent, in a randomized order. The position of each option of the pair (left/right) was counterbalanced.

[8] For example, if the option on the left was low in sustainability, convenience, and attraction but high in preservation/protection, the option on the right was the exact opposite, namely high in sustainability, convenience, and attraction and low in preservation/protection (pair 1, *table 3.1*).

Table 3.1: fractional factorial cyclic design for the creation of seven pairs of product-packaging combinations.

Pairs	Benefit/s sacrificed for higher sustainability	Options	Design 2 levels: 1=low, 2=high			
			Sustainability	Preservation/ protection	Convenience	Attraction
P1	Sacrifice preservation/ protection	Option 1	1	2	1	1
		Option 2	2	1	2	2
P2	Sacrifice convenience	Option 1	1	1	2	1
		Option 2	2	2	1	2
P3	Sacrifice attraction	Option 1	1	1	1	2
		Option 2	2	2	2	1
P4	Sacrifice preservation and convenience	Option 1	1	2	2	1
		Option 2	2	1	1	2
P5	Sacrifice preservation and attraction	Option 1	1	2	1	2
		Option 2	2	1	2	1
P6	Sacrifice convenience and attraction	Option 1	1	1	2	2
		Option 2	2	2	1	1
P7	Sacrifice all other 3 benefits	Option 1	1	2	2	2
		Option 2	2	1	1	1

To induce systematic variations in benefit perceptions, the four structural cues were manipulated (*table 3.2*). This manipulation was informed by the study of Granato et al. (2022b) that investigated cues-benefits relations from designers and consumers' perspective for the same product categories as our study (Granato et al., 2022b)[9].

Table 3.2: Manipulation of product-packaging benefits. High vs low level of each benefit.

Benefits	**Manipulations of packaging cues across product categories**		
	Biscuits	**Baby food**	**Salad**
Sustainability	Biodegradable and compostable material (high) with the official European logo vs plastic (low) Paper (high) vs plastic (low)	Biodegradable and compostable material (high) with the official European logo vs plastic (low) Paper (high) vs plastic (low)	Biodegradable and compostable material (high) with the official European logo vs plastic (low) Paper (high) vs plastic (low)
Convenience	Single serve format (high) vs bulk format (low)	Easy (high) vs difficult to empty packaging format (low)	Re-closable (high) vs non-re-closable packaging (low)
Preservation/ protection	Re-closable (high) vs non-re-closable packaging (low)	Re-closable (high) vs non-re-closable packaging (low)	Rigid box (high) vs flexible bag (low)
Attraction	Transparent/see through (high) vs opaque/non see through (low)	Transparent/see through (high) vs opaque/non see through (low)	Transparent/see through (high) vs opaque/non see through (low)

[9] This represents the previous chapter of this thesis (chapter 2). Based on Granato et. al. (2022b) the cue of "material type" should affect the perception of sustainability, the "format" and "opening/closure mechanism" should both affect the benefits of convenience and preservation and the cue of "transparency level" the benefit of attraction. Results of this research also suggest, for example, that a biodegradable & compostable packaging (plastic) as material type is associated with a high (low) perception in the sustainability benefit.

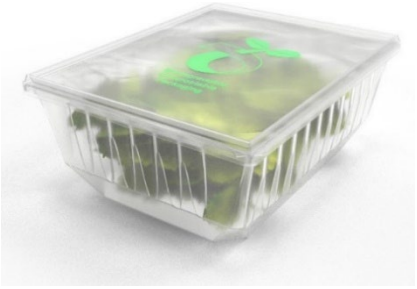
Sustainability level: plastic vs biodegradable/compostable

Definitions for the product of salad:

**Plastic: the packaging is made of conventional plastic*
**Biodegradable and compostable material: it means that the material can decompose and turn into compost.*
**Flexible bag: the packaging is a soft pillow bag*
**Rigid box: the packaging is a rigid box*
**Re-closable packaging: it means that the packaging has a zip or a lid that permit to partially use the product and close it again afterwards.*
**Non-re-closable packaging: once the packaging is open it cannot be reclosed.*
**Transparent: the packaging is see-through, and the product can be seen completely*
**Opaque: the packaging is not see-through, and the product cannot be clearly seen*

Description:

Material: Plastic
Format: Flexible bag
Opening/closure mechanism: Non-re-closable packaging
Colour: Transparent



Description:

Material: Biodegradable and compostable material
Format: Rigid box
Opening/closure mechanism: Re-closable
Colour: Opaque

Definitions for the product of baby food (only when differs from previous ones):

**Re-closable packaging: it means that the packaging has a cup or a lid that permit to partially use the product and close it again afterwards.*
**Easy to empty: the shape of the packaging makes easy to completely empty the product from inside*
**Difficult to empty: the packaging has difficult to reach corners, or a shape that makes difficult to completely empty the product from inside*

Description:

Material: Plastic
Format: Difficult to empty packaging
Opening/closure mechanism: Non-re-closable packaging
Colour: Transparent

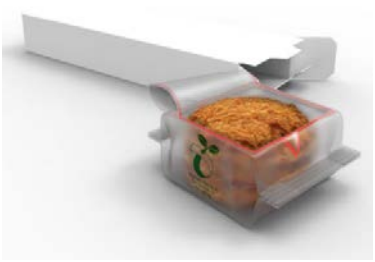
Description:

Material: Biodegradable and compostable material
Format: Easy to empty packaging
Opening/closure mechanism: Re-closable
Colour: Opaque

Definitions for the product of biscuits (only when differs from previous ones):
**Re-closable packaging: it means that the packaging has a zip or a mechanism that permit to partially use the product and close it again afterwards.*
**Non-re-closable packaging: once the packaging is open it cannot be reclosed.*
**Single units packaging: the biscuits are individually packaged, mono portion packaging*
**Entire packaging: the biscuits are all together, large family size*

Description:

Material: Plastic
Format: Entire packaging
Opening/closure mechanism: Non-re-closable packaging
Colour: Transparent



Description:

Material: Biodegradable and compostable material
Format: Single units packaging
Opening/closure mechanism: Re-closable
Colour: Opaque

Sustainability level: plastic vs paper

Definitions (only when differs from previous ones):
**See-through: the packaging is transparent or has a window that is transparent and permits to see the product.*
**Non-see-through the packaging is opaque or does not have any window to see the product.*

Description:

Material: Plastic
Format: Flexible Bag
Opening/closure mechanism: Non-re-closable packaging
Colour: See-through

Description:

Material: Paper
Format: Rigid box
Opening/closure mechanism: Re-closable
Colour: Non-see-through

Description:

Material: Plastic
Format: Difficult to empty packaging
Opening/closure mechanism: Non-re-closable packaging
Colour: See-through

Description:

Material: Paper
Format: Easy to empty packaging
Opening/closure mechanism: Re-closable
Colour: Not see-through

Description:

Material: Plastic
Format: Entire packaging
Opening/closure mechanism: Non-re-closable packaging
Colour: See-through

Description:

Material: Paper
Format: Single units packaging
Opening/closure mechanism: Re-closable packaging
Colour: Not see-through

Figure 3.2: Examples of pairs of product-packaging combinations shown to respondents in the six survey versions. Pair 3 is depicted in this picture with the option 1 (on the left) with profile: 1 (sustainability low), 1 (convenience low), 1 (preservation low), 1 (attraction high) and the option 2 (on the right) with profile: 2 (sustainability high), 2 (convenience high), 2 (preservation high), 1 (attraction low).
All definitions and descriptions are a translation of the respective languages of the survey.

3.3.4 Measures

Intention to purchase one alternative over the other was measured through the question: "*Please look at the packaging below. If you must choose one of these packaging, how likely are you to buy one or the other?*", on a 7-point scale labelled at -3 (I would definitely buy the packaging on the left); 0 (I would equally likely buy either of them); and +3 (I would definitely buy the packaging on the right).

Benefit perceptions were similarly measured through relative scales that measured which of the two options was perceived as superior in one benefit over the other (i.e., "*To what extent do you think that one of the packages is more sustainable/ convenient in use/ appealing and aesthetically beautiful/ preserve and protect the product better/than the other*?"). Answering categories were: -3 (The packaging on the left is definitely more <sustainable>), 0 (they are equally <sustainable>), +3 (the packaging on the right is definitely more <sustainable>). For each of the presented pairs, consumers were first asked their purchase intention and then the four benefit perceptions, in a fixed order. Each scale was presented below the image of the pair.

Consumer values were measured through the 10-item 9-point short Schwartz values survey (SSVS) (Lindeman & Verkasalo, 2005) developed from original Schwartz scale (Schwartz, 1994; Schwartz & Sagiv, 1995). Consumer food lifestyle was measured through the 3-item 7-point Food Related Lifestyle Scale (Grunert et al., 1993). Only the subscales of "search for product information", "enjoyment of shopping", "price sensitivity" and "convenience orientation" were selected from the complete scale, as relevant for this survey (table C.1 and C.2, Appendix C for values and lifestyle scales, at the end of this chapter).

Country of residence was recorded as Netherlands, Germany, Italy, France or Greece, gender as female or male, age was indicated in years by respondents and recoded into the categories 18-30, 31-50, 51-70, 71+ years. Level of education (to quota sample participants) was measured as highest completed level of education and classified into low, medium, and high level in accordance with national education systems.

3.3.5 Data analysis

As preliminary data screening, within subject variance was calculated for the responses on purchase intention and the four benefit perceptions. The 445 (8.84%) respondents who showed no variance in their responses on all these measurements were deemed to have provided irrelevant data (Dewitt et al., 2019)[10] and excluded from the analysis. See table D.1, Appendix D, for the descriptive statistics of the remaining 4590 respondents.

In data analysis and reporting, the position of each option in the pair was re-structured and recoded accordingly, with the option superior in sustainability (option 2) always recoded as the righthand side of the pair. As perceptions and purchase intention ratings are relative scores (positive scores indicate preference for the righthand side stimulus in the paired comparison), dummy variables were created for the packaging cues of material type, format, opening and transparency level by subtracting the value of the option superior in sustainability (option 2) with the value of the option inferior in sustainability (option 1) (2-1= 1 or 1-2= -1).

The proposed model (*figure 2.1*) was tested using path analysis with maximum likelihood estimation in the R package Lavaan (Rosseel, 2012). Path analysis uses a regression method to estimate causal relationships between measured variables (Grapentine, 2000). Causal relations between the four packaging design cues and the benefits' perceptions and between the four benefits' perceptions and purchase intention (including intercept) were tested. The covariances between benefits' perceptions were also included in the model (table E.1, Appendix E, for the complete R script at the end of this chapter).

To test for model robustness across contexts (product categories, consumers' values, lifestyle, and socio-demographic/economic characteristics), and to identify differences and similarities, a multi-group path analysis was performed. The model was tested in different steps: 1) a completely constrained model was tested in which path coefficients, intercepts and covariances were constrained. The variances of intention and benefit

[10] The reason behind this exclusion criterium is that those respondents who assign the same score to every scale shows a very low commitment and do not reflect any plausible response pattern or true preferences.

perceptions could vary[11]. 2) Benefits-intention relations were relaxed: path coefficients between the benefit perceptions and intention, covariances between the benefit and intercept for intention were relaxed across groups. Only cues-benefits relations were kept constrained. 3) Cues-benefits relations were relaxed, while benefit-intention relations were constrained (the opposite of step 2. These steps were conducted for different group comparisons: packaging type (2 groups: sustainability conveyed through biodegradable/compostable material and paper), product categories (3 groups: biscuits/baby food/salad), gender (2 groups: female/male), country (5 groups: Italian/French/German/Dutch/Greek), age (4 groups: 18-30/31-50/51-70/71+), values of universalism and benevolence (2 groups: high/low), and for food lifestyle of "search for information", " convenience orientation", " price sensitivity", "enjoyment of shopping" (2 groups each: high/low). Categorical variables were created for values and lifestyle using a median split[12]. The values of Universalism and Benevolence were selected as part of the "self-transcendence" value dimension most relevant in the study of sustainable food behaviour (Schwartz & Sagiv, 1995). The constructs of the Food Related Lifestyle Scale were screened on reliability, using the value of Cronbach's alpha ($\alpha > .70$ was taken as acceptable).

Model fit was assessed based on three criteria. First, four goodness of fit indices were analysed: 1) Comparative Fit Index (CFI), good if ≥ .95, 2), Tucker-Lewis index (TLI), good if ≥ .95, 3), Root Mean Square of Approximation (RMSEA), good if <.07, and 4), Standardized Root Mean Square Residual (SRMR), good if <.08 (Hair Jnr et al., 2010). Second, Chi-squared difference test was used for nested model comparisons (model 1 vs 2 and 1 vs 3). Third, BIC and AIC values were used for non-nested model comparison (model 2 vs 3) (Werner & Schermelleh-Engel, 2010).

[11] These 5 variances were allowed to vary in all the steps, for model 1, 2 and 3.

[12] Median for Universalism=5.00, Median for Benevolence=6.00 from the 9-point scale.

3.4 Results

3.4.1 Cues-benefits relations and manipulation check

The results of the benefit perceptions confirm the manipulations: consumers perceived the packaging that was designed to convey a higher sustainability benefit (biodegradable/compostable material or paper) as more sustainable than the other packaging (plastic version). The same was found for the other benefit perceptions. When consumers perceived the packaging as more sustainable, they also perceived it as superior on all the other benefits (the values of pairs 1, 2, 3, 5 and 6 are positive on all the benefits) (*figure 3.3*). The mere presence of a biodegradable/compostable material (with its logo) leads consumers to form positive perceptions on other packaging benefits as well (e.g., convenience or attraction). Results suggest that when consumers must sacrifice a single benefit (pair 1, 2 and 3), a higher sustainability level tends to "absorb" the perceived drawbacks in terms of preservation, convenience, or attraction. However, when consumers must sacrifice two or three benefits, the drawbacks become more evident (e.g., pair 4 and 7).

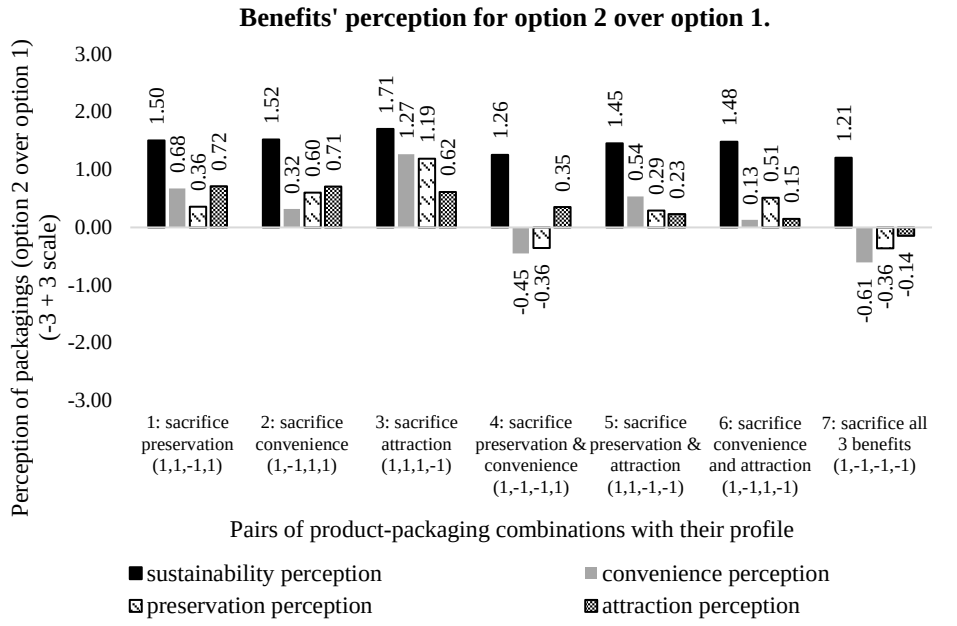


Figure 3.3: Consumers' perceptions of sustainability, convenience, preservation and attraction for option 2 (sustainable one) over option 1 (plastic version). All values are significantly different from zero.

3.4.2 Overall model: relations between packaging design cues, benefits' perceptions and purchase intention

3.4.2.1 Model testing

A path analysis showed that the proposed integrated model has a good fit with the data (*table 3.3*).

Table 3.3: Fit measures for the proposed model.

	χ^2	df[13]	N. parameters to estimate[14]	CFI (≥0.95)	TLI (≥0.95)	RMSEA (<0.07)	SRMR (<0.08)
General model	384.49	3	32	0.99	0.92	0.06	0.01

Path coefficients showed that the four packaging cues of material type, format, opening/closure mechanism, and transparency level significantly and positively influenced the perception of sustainability, convenience, preservation/protection, and attraction (all values are significant at p =.05); validating all relations in the model. The type of material primarily influenced the perception of the sustainability benefit: a change in material type from plastic to biodegradable/compostable or to paper increased the perception of sustainability by 1.49. Changing material type did not only affect the perception of sustainability but also the perception of preservation/protection and attraction. The packaging format and opening/closure mechanism primarily influenced the perception of convenience and preservation, while the transparency level primarily affected the perception of attraction.

[13] The saturated model with one group would have 35 estimated parameters. Direct effects of cues (format, opening type and transparency level) to intention are not modelled. Material type function as a constant in the equation. This results in 3 free degrees of freedom.

[14] In addition to the 20 regressions and 6 covariances in *figure 3.1*, the variances of the five measured constructs of intention, sustainability perception, convenience perception, preservation perception and attraction perception and the value of the intercept for intention were estimated, resulting in 32 parameters to estimate.

A design change from an opaque to a transparent packaging led consumers to perceive the packaging as more appealing and aesthetically more beautiful, by 0.27 (*figure 3.4*).

Shifting the focus to the benefits-intention relations, path coefficients showed that the importance consumers attribute to the benefits of sustainability, convenience, attraction, and preservation/protection significantly affected purchase intention for the sustainable alternative and together explain 20% of the variance in purchase intention (R^2=0.20). The results also revealed substantial correlations between the perceived benefits of convenience and preservation/protection (0.55), suggesting that consumers might perceive a packaging that preserves and protects the product as highly convenient (and the other way around as well) (*figure 3.4*). For complete data, see table E.2, Appendix E, at the end of this chapter.

While this model explains how packaging design cues relate to benefit perceptions and how these, in turn, are translated into a purchase intention, it does not show how consumers trade off and compromise the perceived benefits. Therefore, the next section focusses on the benefits-intention relations from the benefits-costs trade-off perspective.

3.4.2.2 Benefits-intention: consumers' willingness to trade off and purchase

Consumers' intention to purchase the sustainable alternative significantly differed across pairs of product-packaging combinations. If consumers had to sacrifice a single benefit for a higher sustainability level, they preferred to sacrifice preservation/protection (pair 1). If consumers had to sacrifice two benefits, they were more willing to sacrifice preservation/protection and attraction (pair 5). Purchase intention for the sustainable alternative is lower when consumers must sacrifice all the other three benefits (pair 7). Overall, consumers intended to purchase the sustainable alternative (biodegradable/compostable or paper version) over the non-sustainable (plastic version, values are all above zero) (*table 3.4*).

Table 3.4: Consumers' intention to purchase the sustainable alternative (option 2) over the plastic version (option 1). Mean (SD). F value= 149.59; p value=.000

	PAIR 1	**PAIR 2**	**PAIR 3**	**PAIR 4**	**PAIR 5**	**PAIR 6**	**PAIR 7**
				Benefit/s sacrificed			
Inherent trade off and pair profiles	preservation (1,1, -1,1)	convenience (1, -1,1,1)	attraction (1,1,1, -1)	preservation& convenience (1, -1, -1,1)	preservation & attraction (1,1, -1, -1)	convenience & attraction (1, -1,1, -1)	all 3 benefits (1, -1, -1, -1)
Purchase intention (scale -3, +3)	1.44[a] (2.04)	0.95[b] (2.27)	1.16[c] (2.20)	0.74[d] (2.32)	0.93[b] (2.26)	0.43[e] (2.39)	0.24[f] (2.40)

Columns sharing the same superscript letter are not significantly different at the .05 level (Crosstabs with pairwise z-test Bonferroni corrected). All values are significantly different from zero.

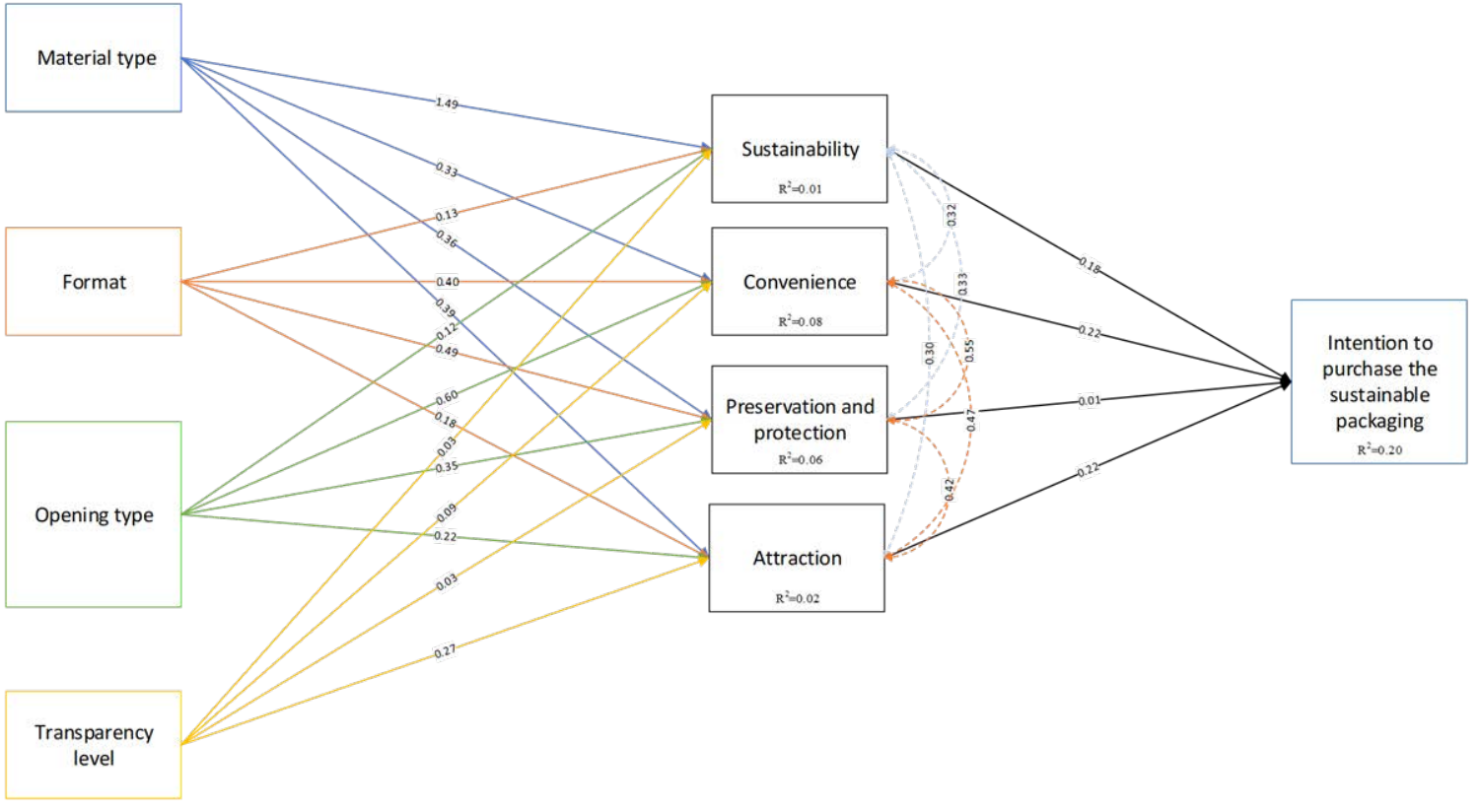


Figure 3.4: Path coefficients (unstandardized) for the general model. All values are significant at p<.05. Intercept for intention.

3.4.2.3 Model validation- packaging type and product categories

A multi-group path analysis showed that the developed general model is robust across differences in packaging type. The fully constrained model presents a good fit (χ^2=1575.96, df=33, CFI=0.96, TLI=0.94, RMSEA=0.05, SRMR=0.04) (*table 3.5*).

The model validation against different product categories showed that the constrained model does not present a good fit, providing reasons to relax the model (χ^2=5128.53, df=63, CFI=0.88, TLI=0.86, RMSEA=0.09, SRMR=0.07). After relaxing the benefits-intention relations, the model did not show any significant improvement (fit indices still below the cut off values). Relaxing the cues-benefits relations, instead, showed an improvement in model fit (χ^2=2137.15, df=31, CFI=0.95, TLI=0.88, RMSEA=0.08, SRMR=0.04) (*table 3.5*). The chi squared difference test showed that the constrained model (model 1) and the model in which the cues-benefits relations have been relaxed (model 3) were significantly different from each other and that the latter is significantly better (lower values of AIC and BIC). In addition, BIC and AIC values showed that model 3 is better than model 2 (*table 3.6*). Therefore, the results suggested that differences in product categories influence the relations between packaging cues and benefits' perceptions (*table 3.5 and 3.6*). Looking at the path coefficients for the model in which the cues-benefits relations have been allowed to vary across product categories, results showed how packaging cues relate to benefit perceptions depend on product categories.

Table 3.5: Fit indexes for the models with packaging type and product categories as a group. Number of observations= 32132.

Group	Model type	N. parameters to estimate	Fit measures					
			χ^2	df	CFI (≥0.95)	TLI (≥0.95)	RMSEA (<0.07)	SRMR (<0.08)
Packaging type (2 groups)	1. Completely constrained	37	1575.96	33	**0.96**	0.94	**0.05**	**0.04**
Product category (3 groups)	1. Completely constrained	42	5128.53	63	0.88	0.86	0.09	**0.07**
	2. Relax benefits-intention relations[15]	64	3969.37	41	0.91	0.83	0.09	**0.06**
	3. Relax cues-benefits relations[16]	74	2137.15	31	**0.95**	0.88	0.08	**0.04**

Table 3.6: Chi squared difference test for nested model comparison for product category (model 1 vs 2 and model 1 vs 3)

Product category	Model 1 vs 2	Model	df	AIC	BIC	χ^2 diff	df diff.	P value
		Model 2	41	665581	666117			
		Model 1	63	666696	667048	1159.2	22	<.001
	Model 1 vs 3	Model 3	31	663768	664388			
		Model 1	63	666696	667048	2991.4	32	<.001

A change in material type from plastic to biodegradable/compostable or paper increased the sustainability perception of the biscuit packaging by 1.57, of the baby food packaging by 1.39, and of the salad packaging by 1.51 (*table 3.7*). Opening type was particularly important for baby food products where a re-closable packaging could increase the perception of convenience

[15] 11 parameters per model are relaxed (4 benefits-intention regressions, 1 intercept and 6 covariances).

[16] 16 parameters per model are relaxed (16 cues-benefits regressions).

(0.92) and attraction (0.40). Opening type was also important for the product of salad in affecting the perception of convenience (0.70) and preservation (0.58). The transparency level of the packaging increased the perception of attraction for the product of biscuits (0.32) and salad (0.42) (*table 3.7*).

Table 3.7: Path coefficients (unstandardized) between design cues and benefit perceptions in the multi-group path analysis with product category as a group. Values with the superscript "ns" indicate non significance at p<.05.

Design cues	Benefits' perception	Product categories		
		Baby food	Biscuits	Salad
Sustainability	Material Type	1.39	1.57	1.51
	Format	0.12	0.25	0.03^{ns}
	Opening type	0.20	-0.08	0.23
	Transparency level	0.01^{ns}	0.01^{ns}	0.06
	R^2	0.01	0.02	0.01
Convenience	Material Type	0.31	0.39	0.30
	Format	0.26	0.84	0.11
	Opening type	0.92	0.19	0.70
	Transparency level	0.03^{ns}	0.08	0.16
	R^2	0.14	0.13	0.10
Preservation/protection	Material Type	0.33	0.38	0.38
	Format	0.55	0.71	0.20
	Opening type	0.17	0.31	0.58
	Transparency level	-0.03^{ns}	0.02^{ns}	0.11
	R^2	0.06	0.11	0.07
Attraction	Material Type	0.38	0.45	0.34
	Format	0.15	0.19^{ns}	0.21
	Opening type	0.40	0.01^{ns}	0.19
	Transparency level	0.07	0.32	0.42
	R^2	0.04	0.02	0.04

3.4.2.4 Model validation- consumer characteristics

The general model showed to be robust across several consumer characteristics, as gender, age, self-transcendent values, and food related lifestyle. For these groups, the fully constrained model showed good fit, providing no reason to relax the model (*table 3.8*).

The fully constrained model with country as a group showed insufficient fit with the data (χ^2=5358.71, df=123, CFI=0.87, TLI=0.87, RMSEA=0.08, SRMR=0.07). After relaxing the benefits-intention relations, the model did not show sufficient improvement (χ^2=3803.54, df=79, CFI=0.91, TLI=0.85, RMSEA=0.09, SRMR=0.05). Relaxing the cues-benefits relations, instead, further improved the model fit (χ^2=2069.11, df=59, CFI=0.95, TLI=0.89, RMSEA=0.07, SRMR=0.05). The chi-squared difference test also showed a significant improvement of the model in which the cues-benefits relations could vary across countries (model 3) compared to the fully constrained model (model 1). BIC and AIC values also showed that model 3 is better than model 2 (*table 3.9*). Therefore, country related differences influenced how packaging design cues relate with benefit perceptions.

Table 3.8: Fit measures for the models for gender, age, values, lifestyle and country.

Consumers' characteristics	Model type	Fit indices						
		N. Parameters to estimate	χ^2	Df	CFI (≥0.95)	TLI (≥0.95)	RMSEA (<0.07)	SRMR (<0.08)
Gender (2 groups)	1. Completely constrained model	37	668.47	33	**0.98**	**0.97**	**0.03**	**0.02**
Age (4 groups)	1. Completely constrained model	47	874.63	93	**0.98**	**0.98**	**0.03**	**0.03**
Self-transcendent value of universalism	1. Completely constrained model	37	904.12	33	**0.98**	**0.97**	**0.04**	**0.03**
Self-transcendent value of benevolence	1. Completely constrained model	37	776.65	33	**0.98**	**0.97**	**0.04**	**0.03**
Lifestyle "search for information"	1. Completely constrained model	37	830.71	33	**0.98**	**0.97**	**0.04**	**0.03**
Lifestyle "convenience orientation"	1. Completely constrained model	37	1323.02	33	**0.97**	**0.95**	**0.05**	**0.03**
Lifestyle "price sensitivity"	1. Completely constrained model	37	545.37	33	**0.99**	**0.98**	**0.03**	**0.03**
Lifestyle "enjoyment of shopping"	1. Completely constrained model	37	742.10	33	**0.98**	**0.97**	**0.04**	**0.03**
Country (5 groups)	1. Completely constrained model	52	5358.71	123	0.87	0.87	0.08	**0.07**
	2. Relax benefits-intention (right part)	96	3803.54	79	0.91	0.85	0.09	**0.05**
	3. Relax cues-benefits (left part)	116	2069.11	59	**0.95**	0.89	0.07	**0.05**

Table 3.9: Chi squared difference test to compare nested models with country as a group (model 1 vs 2 and model 1 vs 3).

Country	Model 1 vs 2	Model	Df	AIC	BIC	χ^2 diff	Df diff.	P value
		Model 2	79	664793	665597			
		Model 1	123	666260	666695	1555.2	44	<.001
	Model 1 vs 3	Model 3	59	663098	664070			
		Model 1	123	666260	666695	3289.6	64	<.001

The path coefficients of model 3 (with country as a group) showed that a change in material type can affect sustainability perception to a different extent. For Italian consumers, for example, a change in material type from plastic to biodegradable/compostable or paper increases sustainability perception by 2.05. (*table 3.10*). For German consumers the increment is of 1.81, for Dutch consumers of 1.77, for Greek consumers of 1.09 and for French consumers of 0.76.

Table 3.10: Path coefficients (unstandardized) between design cues and benefit perceptions in the multi-group path analysis with country as a group. Values with the superscript "ns" indicate non significance at p<.05.

Design cues	Benefits' perception	Countries				
		France	**Germany**	**Greece**	**Italy**	**Netherlands**
Sustainability	Material Type	0.76	1.81	1.09	2.05	1.77
	Format	0.32	0.09	0.16	0.03^{ns}	0.08
	Opening type	0.24	0.06	0.18	0.08	0.01^{ns}
	Transparency level	0.05^{ns}	0.04^{ns}	0.06	-0.00^{ns}	-0.01^{ns}
	R^2	0.03	0.00	0.01	0.00	0.00
Convenience	Material Type	0.34	0.44	0.36	0.44	0.11
	Format	0.51	0.31	0.34	0.39	0.46
	Opening type	0.75	0.34	0.49	0.65	0.77
	Transparency level	0.08	0.09	0.10	0.08^{ns}	0.10
	R^2	0.12	0.03	0.06	0.09	0.12
Preservation/protection	Material Type	0.43	0.38	0.57	0.45	0.00^{ns}
	Format	0.48	0.37	0.44	0.57	0.57
	Opening type	0.47	0.18	0.31	0.40	0.41
	Transparency level	0.00^{ns}	0.05^{ns}	0.02^{ns}	0.04	0.05^{ns}
	R^2	0.08	0.03	0.05	0.08	0.09
Attraction	Material Type	0.40	0.49	0.53	0.45	0.10
	Format	0.26	0.10	0.22	0.16	0.18
	Opening type	0.29	0.08	0.22	0.19	0.21
	Transparency level	0.26	0.22	0.27	0.25	0.35
	R^2	0.03	0.01	0.02	0.02	0.03

3.5 Discussion

3.5.1 Theoretical implications

Through an online survey approach in which pairs of stimuli reflect an inherent benefits' trade off, this research investigated how today's European consumers cope with sustainable product-packaging decisions when these involve a sacrifice and compromise. Thanks to the fractional cyclic design, the nature and intensity of the trade-off between different benefits becomes visible. This provides a more realistic understanding of the trade-off in the field of sustainable development and extends the existing literature on sustainable packaging acceptance. Such literature has mainly focused on the sustainability benefit per se, for example, on how to improve the sustainability communication of the packaging (Granato et al., 2022a; Magnier & Crié, 2015), or on how consumers are responding to eco alternatives (Magnier & Schoormans, 2015; Steenis, 2019; Steenis et al., 2017). However, little attention has been drawn to the role of sustainability in relation to the other competing benefits, particularly convenience, preservation/protection, and attraction.

By integrating a two-step process into an overall model, the cues-benefits relations and the benefits-intention relations, the present work integrates two research lines in the packaging design field, mainly focused either on the cue perception or cue evaluation stage. By combining the cues-benefits relations and the benefits-intention relations in a single path model, this research advances the understanding of the mediating mechanism and underlying processes behind consumer acceptance of sustainable product-packaging innovations. Rather than focusing on the direct effect between eco-packaging design and consumer purchase intention, this research sheds the light on indirect effects, the benefit perceptions, and trade-off processes. The study of indirect effects has been recognized as crucial to truly enrich the current understanding of the factors influencing sustainable consumption and choices (Li et al., 2021a, 2021b).

Moreover, adding beyond previous packaging design studies (Lindh et al., 2016b; Steenis et al., 2017), our results showed how the perception and evaluation process of product-packaging combinations is not the result of a one-to one relation but of many-to-many relations. In this regard, our results show that packaging cues, such as the material type, do not only have a

strong effect on perceived sustainability, but can also substantially affect other benefit perceptions, like the aesthetic quality or the perceived ability to preserve and protect the content.

Furthermore, the present work offers important contributions on the topic of "the power of sustainability". Our results showed that the sustainability appreciation can be so strong that it absorbs some of the losses on other benefits (e.g., in terms of preservation). However, results also reveal that if sustainability comes at a too high price or loss, such absorption capacity fails, and consumers still perceive the drawbacks. This phenomenon might relate to a higher-level assimilation effect through which positive associations triggered by sustainability absorb negative experiences, preventing consumers from perceiving certain losses.

Similarly, our results showed that the presence of a biodegradable/compostable material (with its logo) leads consumers to form favourable evaluations on other packaging benefits (e.g., convenience or attraction), besides sustainability. Consumers indeed tended to perceive the more sustainable option as superior on the other benefits as well. This might be caused by a sustainability halo affect or "spill-over" (Chandon & Wansink, 2007; Schuldt et al., 2012; Sundar & Kardes, 2015), through which consumer positive impressions based on one (packaging) aspect, sustainability in this case, tend to "spill-over" to other unrelated packaging benefits, as convenience (Steenis et al., 2017).

Finally, this research adds to the understanding on how product/packaging and consumer characteristics might influence purchase intention of sustainable packaging. The results show that while the benefits-intention relations (right part of the model) do not vary across product, packaging and consumers' differences, the cues-benefits relations (left side of the model) might do. Our research suggests that product and country related differences affect the extent to which design cues lead to benefit perceptions, rather than affecting the benefit trade off. Distinctive product categories, like baby food, biscuits, and salad, require distinctive packaging functions and specifications, in turn leading to different benefit perceptions.

3.5.2 Managerial implications

A key challenge in the eco (packaging) design process lies in balancing between the benefits derived from a higher environmentally efficiency and the possible drawbacks. In terms of consumer perceptions, our results show that when consumers must sacrifice a single benefit for greater sustainability, they tend not to perceive the potential drawbacks, such as an objectively inferior performance in terms of convenience, preservation, or attraction. Thus, a higher sustainability level seems to "absorb" some of the drawbacks until a certain threshold, beyond which the losses are perceived. Therefore, while developing more sustainable packaging alternatives, it should be considered that a higher sustainability level tends to mitigate or even absorb the drawbacks (e.g., opacity level) when these are limited (e.g., when a single benefit is compromised), leading consumers to still hold positive attitudes toward the sustainable packaging. When, on the other hand, the sacrifice asked to consumers is greater, packaging designers should carefully consider which benefits consumers are most willing to compromise. Our results suggest that consumers might be more willing to accept a packaging perceived as inferior in preservation and attraction if perceived superior in sustainability. In this regard, though, it may be important to consider how consumers balance between the direct (packaging disposal) and indirect environmental impact of packaging (food waste), as the latter is often mistakenly perceived as less severe by consumers (Brennan et al., 2021; INCPEN, 2019; Lindh et al., 2016b).

Moreover, the results of the model validation suggest that product and country related differences are likely to affect how packaging design cues translate into benefit perceptions. Therefore, in the process of "re-designing" for an improved product-packaging sustainability, packaging developers might want to consider how cues-benefits relations change across different contexts and consumer characteristics. For example, changing an opening/closure mechanism from a non-re-closable packaging to re-closable (with a zip, lid) is likely to increase the perceived sustainability for certain products, as baby food and fresh salad, but significantly decrease it for others (as biscuits). In this case, it might be worthy to consider whether the balance between food waste and packaging waste is equally or differently relevant across product categories. Similarly, packaging designers might consider that the benefits that packaging cues might signal to consumers differ across countries. Our results show that, for German consumers, convenience in

mainly signalled by material type, for the French by packaging format and for the Dutch by the opening/closure mechanism.

3.6 Limitations and future research

The current study has some limitations that should be acknowledged. First, this study shares the same limitation of other self-reported surveys that measured expressed purchase intentions, rather than actual behaviour. Although purchase intention has been considered as a key predictive component of purchase behaviour (Fishbein & Ajzen, 1977; Fishbein et al., 1980; Follows & Jobber, 2000), the comparison between expressed purchase intention and actual behaviour has been challenging (Barber et al., 2012; Follows & Jobber, 2000; Lange et al., 2002; Morwitz, 1997). In the context of sustainable purchase behaviour, self-reported measures have often produced a halo effect, leading respondents to over-report environmentally responsible behaviour, that is actually not fully adopted (Barber et al., 2009; Follows & Jobber, 2000; Roozen & Pelsmacker, 1998). However, the fractional cyclic design mitigates this limitation and increases the realism of the choice context, by including relative responses and options with competing and mutually exclusive features.

Second, instead of measuring the extent to which consumers perceive and prefer one packaged product over the other, as in our study design, future research could adopt a more classical choice model, where respondents are asked to choose one of the two options. In this regard, hybrid choice models may hold potential for future research avenues, as an alternative way to look at the effect of benefit perceptions (the mediator) on purchase intention (Ben-Akiva et al., 1994; 2002; Kim at al., 2014).

Third, while using packaging prototypes with no labels or brands increased the internal validity of our study, avoiding cross-cultural differences in brands, language, and other communication issues, it can compromise on external validity. In real purchase scenarios, consumers may be less likely to compare an extensive set of packaging pairs, only varying on a limited set of cues, compared to an experimental setting. In this respect, it is important to consider that, although packaging highly influences choices, consumers purchase food products (that are packaged) and not packaging per se. Again, the fractional factorial design compensates on this limitation and increases

the external validity, re-creating a certain realism of the shopping environment.

Last, future research could investigate additional ways in which packaging design cues can contribute to sustainability perception, besides the structural cues of the present work. For example, more specific changes in the sensory packaging properties, as in the tactile, auditory, visual aspects of the packaging or verbal elements might be added for a more exhaustive representation of potential redesign strategies to signal sustainability to consumers or any other benefits. This, in turn, might also lead to more explained variance than in our study. Similarly, while the present study focuses on bioplastics and paper materials as more sustainable packaging design configurations, future research may investigate consumer perceptions of other design efforts, such as recycled materials or innovative technologies able extend food shelf life and prevent food waste.

Despite these limitations, the present research advances the understanding of "the price of sustainability", and specifically, of how consumers perceive and evaluate sustainable product-packaging alternatives, when these involve a trade-off between sustainability and other decision criteria. By combining packaging design cues, benefit perceptions and contextual factors (as product/packaging and consumers' differences) in an overall model, this research contributes to a more realistic and fuller understanding of consumer acceptance of sustainable technologies and its determinants. These insights reveal a robust, valid, and generalizable model across different product-packaging contexts and consumer characteristics.

3.7 Acknowledgments

The authors of this research thank the food and packaging companies within the MYPACK consortium for the brainstorming session on the stimulus material and the graphic designer Sem Lootsma for the actual development of the 3D images.

3.8 Appendices

Appendix C: Values and lifestyle

Appendix D: Details of the respondents

Appendix E: R script and complete data

Appendix C: Values and lifestyle

Table C.1: Consumers' values asked to the respondents in randomized order

"*Please, rate the importance of the statements below as life guiding principles for you*" with scale points labelled as: -1 (Opposed to my principles), 0 (not important), 3 (important), 7 (of supreme importance). Power: social power, authority, and wealth Achievement: success, capability, ambition, and influence on people and events Hedonism: gratification of desires, enjoyment in life, and self-indulgence Stimulation: daring, a varied and challenging life, and an exciting life Self-Direction: creativity, freedom, curiosity, independence, and choosing one's own goals Universalism: broadmindedness, beauty of nature and arts, social justice, a world at peace, equality, wisdom, unity with nature, and environmental protection Benevolence: helpfulness, honesty, forgiveness, loyalty, and responsibility Tradition: respect for tradition, humbleness, accepting one's portion in life, devotion, and modesty Conformity: obedience, honouring parents and elders, self-discipline, politeness Security: national security, family security, social order, cleanliness, and reciprocation of favours

Table C.2: Food lifestyle scale

"*Please state the extent to which you agree on the following statement*", with scale labelled as 1 (definitely disagree) to 7 (definitely agree). Importance of product information - To me, product information is of high importance. I need to know what the product contains - I compare labels to select the best product for me - I compare labels to decide which brand to buy
Enjoyment of shopping - Shopping for food bores me - I just love shopping for food - Shopping for food is like a game to me
Price criterion - I always check prices, even on small items. - I notice when products I buy regularly change in price - I watch for advertisements for the store specials and plan to take advantage of them when I go shopping

Convenience - I use frozen food for at least one meal a day - To me, the microwave oven is essential for my cooking. - I use lot of mixes, for instance baking mixes or powder soups

Appendix D: Details of the respondents

Table D.1: Descriptive statistics of the respondents (N= 4590)

Variable		Percentage
Product category	Baby food	33.4%
	Biscuits	33.4%
	Salad	33.2%
Packaging type-sustainability manipulation	Biodegradable/compostable	50%
	Paper	50%
Gender	Female	51.3%
	Male	48.7%
Age	18-30 years	19.8%
	31- 50 years	39.2%
	51-70 years	35.9%
	71 +	5.2%
Educational level	low	17.5%
	medium	42.6%
	high	39.9%
Country	France	20.1%
	Germany	19.0%
	Greece	20.4%
	Italy	19.7%
	Netherlands	20.8%

Appendix E: R-script and Complete data

Table E.1: R script for testing the general model

```
setwd()
install.packages("readr")
library(readr)
installpackages("lavaan")
library(lavaan)

PathData<-read_csv ("PathData.csv)

Model1<-"
SustainabilityPerception ~ Format + Opening + Transparency
ConvenienceePerception ~ Format + Opening + Transparency
PreservationPerception ~ Format + Opening + Transparency
AttractivenessPerception ~ Format + Opening + Transparency

Intention ~ c1*1 + SustainabilityPerception + ConvenienceePerception +
AttractivenessPerception + PreservationPerception

ConvenienceePerception ~~ PreservationPerception
ConvenienceePerception ~~ AttractivenessPerception
ConvenienceePerception ~~ SustainabilityPerception
SustainabilityPerception ~~ AttractivenessPerception
SustainabilityPerception ~~ PreservationPerception
AttractivenessPerception ~~ PreservationPerception"
fitmod1<-sem(Model1, data=PathData, auto.var=TRUE)
summary(fitmod1, fit.measures=TRUE, standardized=TRUE, rsquare=TRUE,
modindices=TRUE)
fitmeasures(fitmod1,c("cfi", "tli", "rmsea", "srmr", "chisq", "df"))
```

Table E.2: Complete data from the integrated model

Regressions:

	Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all
Sustainability Perception ~						
Format	0.135	0.012	11.262	0.000	0.135	0.065
Opening	0.116	0.012	9.678	0.000	0.116	0.056
Transparency	0.028	0.012	2.342	0.019	0.028	0.013
Convenience Perception ~						
Format	0.403	0.013	31.590	0.000	0.403	0.175
Opening	0.604	0.013	47.406	0.000	0.604	0.263
Transparency	0.089	0.013	6.989	0.000	0.089	0.039
Preservation Perception ~						
Format	0.489	0.012	40.375	0.000	0.489	0.226
Opening	0.355	0.012	29.330	0.000	0.355	0.164
Transparency	0.031	0.012	2.544	0.011	0.031	0.014
Attractiveness Perception ~						
Format	0.186	0.012	15.436	0.000	0.186	0.088
Opening	0.201	0.012	16.759	0.000	0.201	0.096
Transparency	0.272	0.012	22.665	0.000	0.272	0.129
Intention ~						
Sustainability perception	0.176	0.006	29.054	0.000	0.176	0.157
Convenience perception	0.223	0.006	34.550	0.000	0.223	0.220
Attraction perception	0.218	0.006	33.736	0.000	0.218	0.198
Preservation perception	0.012	0.007	1.782	0.075	0.012	0.011

Covariances:

	Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all
Convenience Perception ~~						
Preservation perception	2.377	0.029	83.264	0.000	2.377	0.525
Attraction perception	2.113	0.028	76.174	0.000	2.113	0.469
Sustainability Perception ~~						
Convenience perception	1.422	0.026	54.039	0.000	1.422	0.316
Attraction perception	1.243	0.025	50.405	0.000	1.243	0.293
Preservation perception	1.364	0.025	54.555	0.000	1.364	0.320
Preservation Perception ~~						
Attraction perception	1.772	0.026	68.639	0.000	1.772	0.415

Intercepts (material type):

	Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all

Sustainability perception	1.492	0.012	124.212	0.000	1.492	0.723
Convenience perception	0.335	0.013	26.264	0.000	0.335	0.147
Preservation perception	0.363	0.012	30.027	0.000	0.363	0.170
Attraction perception	0.390	0.012	32.445	0.000	0.390	0.187
Intercept:						
Intention	0.479	0.014	33.763	0.000	0.479	0.208
Variances:						
	Estimate	Std.Err	z-value	P(>|z|)	Std.lv	Std.all
Sustainability perception	4.238	0.033	126.752	0.000	4.238	0.994
Convenience perception	4.774	0.038	126.752	0.000	4.774	0.920
Preservation perception	4.303	0.034	126.752	0.000	4.303	0.936
Attraction perception	4.245	0.033	126.752	0.000	4.245	0.977
Intention	4.247	0.034	126.752	0.000	4.247	0.800
R-Square:						
	Estimate					
Sustainability perception	0.006					
Convenience perception	0.080					
Preservation perception	0.064					
Attraction perception	0.023					
Intention	0.200					

4

Chapter IV

A meaningful reminder on sustainability: when explicit and implicit packaging cues meet.

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Abstract

Sustainable packaging innovations are becoming increasingly available in the marketplace. However, their communication to consumers remains a challenging task, as neither their distinctiveness nor their higher sustainability level is recognized. Contributing to research in environmental psychology, the current chapter conceptualized and tested the new concept of meaningful reminder as a strategy to communicate such distinctiveness and higher sustainability. To understand how a meaningful reminder can be created and used, this research investigated how eco explicit (logos, labels and statements) and implicit packaging design cues (auditory, tactile and visual elements) combine and interact and how such a combination can be used to the advantage of sustainability, to increase sustainability salience, perception and sustainable disposal behaviour of the packaging and its content. Across three lab studies and different measures (lexical decision task, thought listing task, self-reported scales and observations of consumer disposal behaviour), we identify the conditions under which combining explicit and implicit cues can be counterproductive, not leading to any increase or even a decrease in sustainability salience and perception. However, under different conditions, we show how sustainability salience, perception of packaging sustainability and even consumer sustainable disposal behaviour can be positively affected.

Key words: sustainability communication, packaging design, explicit cues, implicit cues, sustainability perception, sustainable behaviour.

4.1 Introduction

It is widely recognized that current patterns of mass production and consumption have not only contributed to welfare, but also created immense environmental problems, profoundly contributing to pollution, global warming and destruction of natural ecosystems (Krausmann et al., 2009; Oreskes, 2018). Packaging industry is one of the main actors, as almost all mass-produced goods have a packaging, which is functional for the transport, preservation and sales of such goods (Magnier & Schoormans, 2015; Meherishi et al., 2019; Steenis et al., 2017). Despite its essential roles in facilitating efficient logistics, preventing product losses and as a "silent salesman" (Rod, 1990), packaging is "moving waste". Once it reaches the end user, it is a mere container that is thrown away. Only in Europe, more than 60 million tons of packaging waste are produced every year, negatively affecting the ecological footprint (Eurostat, 2018).

As a result, consumers, businesses, governments, science, and society at large are increasingly demanding actions to reduce the impact of packaging, both at the industrial level (reducing environmental impact of materials) and at consumer level (through more sustainable disposal behaviour) (Carrus et al., 2008; Esslinger, 2011; Grinstein & Nisan, 2009; Peattie & Peattie, 2009; Sonneveld et al., 2005). At the forefront of such effort, increasingly many industries are committed to eco-design, by for example developing and promoting new packaging alternatives with a lower environmental impact (Del Borghi et al., 2020; Guillard et al., 2018). Biobased, biodegradable, compostable, recycled materials or (packaging-related) technologies able to extend the shelf life of products and reduce their waste are rapidly becoming available in the marketplace (Boz et al., 2020; Guillard et al., 2018).

Despite technological investments to increase their environmental efficiency, eco-packaging innovations are often not recognized by consumers in terms of 1) newness and distinctiveness and 2) improved sustainability (Magnier & Schoormans, 2015). Sustainability communication of these technologies thus remains a challenging task, limiting their market potential and, in turn, their real environmental efficiency, that ultimately lies in the hands of consumers (Magnier & Schoormans, 2017; Steenis et al., 2017).

The current research conceptualizes and tests the new concept of *meaningful reminder*, as a strategy to improve the sustainability communication of eco (packaging) innovations. We argue that to be properly recognized (in terms of distinctiveness and improved sustainability) eco-packaging innovations need to include an optimal combination of design elements that function as a *reminder*, disrupting from consumer automated behaviour as reflected in routines and habits, and reminding the distinctiveness and newness of the packaging and, additionally, as a *meaning provider*, re-storing the cognitive flow by conveying the intended meaning (sustainability). In order to investigate how such a meaningful reminder can be created, a deep understanding of how diverse packaging design elements combine and interact in affecting sustainable responses and their underlying psychological processes is essential, as increasingly advocated in the environmental psychological literature (Bamberg, 2003; Carrus et al., 2008; Costarelli & Colloca, 2004; Koenig-Lewis et al., 2014).

Prior research has largely explored how isolated packaging design elements affect consumer responses (Ampuero & Vila, 2006; Creusen & Schoormans, 2005; Hultén, 2011; Pancer et al., 2017; Steenis et al., 2018; Steenis et al., 2017), either through an informational or through an inferential belief formation route (Fishbein & Ajzen, 1977; Steenkamp, 1990). Explicit cues, in the form of statements, labels or claims, have long been studied in the packaging design literature for their explicit persuasive power (Bickart & Ruth, 2012; Grunert et al., 2014; Kronrod et al., 2012; Magnier & Schoormans, 2015; Rossi & Rivetti, 2020). These type of cues are purposively, deliberatively and consciously used by consumers as diagnostic sources for inferring product and packaging benefits (e.g., sustainability) (Lähteenmäki et al., 2010; Roberto et al., 2012; van Ooijen et al., 2017).

In addition, research has focused on implicit cues, such as visual (e.g., colours, overall look), tactile or auditory packaging elements, and on how these influence consumer reactions, by drawing attention (Garber Jr et al., 2008; Schoormans & Robben, 1997; Underwood et al., 2001), affecting categorization and perceptions (Granato et al., 2022b; Lindh et al., 2016a; Raghubir & Greenleaf, 2006; Silayoi & Speece, 2004) or triggering specific emotions (Clark et al., 2021; Koenig-Lewis et al., 2014; Liao et al., 2015). Whereas explicit cues explicitly convey meanings to consumers predominantly through a deliberate, cognitive and informational belief

formation route (Fishbein & Ajzen, 1977; Steenkamp, 1990), implicit cues connote a symbolic, abstract and implicit meaning through an associative inferential route (Lindh et al., 2016a; Steenis et al., 2017; Underwood, 2003). Implicit cues are more likely than explicit cues to be processed automatically and unconsciously, serving as rather implicit tools for product-packaging communication (Becker et al., 2011; Dijksterhuis et al., 2005; Karjalainen, 2007; van Ooijen et al., 2017).

Implicit and explicit cues typically co-occur in a holistic packaging design to convey relevant and accurate meaning to the consumer (van Ooijen et al., 2017) with the potential to function as a meaningful reminder. However, attention on such interaction effect is lacking (van Ooijen et al., 2017) and, up to our knowledge, no research has focused on how implicit and explicit cues combine and interact in affecting consumer responses regarding sustainability.

Existing literature brings forward conflicting perspectives in this regard. On the one hand, combinations of cues have been advocated (Bocken et al., 2016), as they might increase the persuasive effect of the packaging by increasing the amount of arguments and information (Eagly & Warren, 1976; Magnier & Schoormans, 2015; Petty & Cacioppo, 1984). Others, however, have argued that this effect is not so straightforward and may even backfire when the combination of eco design elements leads to a "green consumer confusion" or "green scepticism" (Irwin & Spira, 1997; Magnier & Schoormans, 2015; Mitchell et al., 2005; Vincent-Wayne & Vassilios, 1999). Adding more cues is thus not necessarily better.

The present research has the interrelated aims of 1) providing more clarity on the controversial effect of the combination of eco implicit and explicit packaging cues, and 2) exploring how such a combination can be used to promote sustainability, through what we coin as " a meaningful reminder". To do so, the following research questions are addressed: *"How do eco implicit and explicit packaging design cues combine and interact in affecting sustainability salience, perception and sustainable disposal behaviour?"* and *"How can this combination of implicit and explicit design cues be used to create a meaningful reminder, as a strategy to enhance sustainability communication?*

4.2 Theoretical background

4.2.1 Design elements as reminders for newness and distinctiveness

Packaging sustainability involves different configurations, relating to the input materials (biobased and recycled) and end-of-life stream (biodegradability or recyclable), next to technological features that may extend the shelf life of products (Bruijnes et al., 2020; Van den Oever et al., 2017). Various technologies are available, which often carry sensory features different from those of conventional plastics (Guillard et al., 2018; Sirviö et al., 2013; ten Klooster, 2008). For example, biomaterials, such as PLA (Polylactic Acid) present a distinct sound when handled (Diaz et al., 2016; Evans et al., 2020), recycled plastics (e.g. PET) present a non-uniform look[17] (Yam, 2010) and biodegradable and compostable materials have a different opacity or tactile properties, compared to conventional plastics (Guillard et al., 2018; Sirviö et al., 2013; ten Klooster, 2008).

In the communication to consumers, these distinctive sensory properties (e.g. different sound, touch feeling) can be either mitigated, through an imitation strategy, or highlighted, through a differentiation strategy (Magnier & Schoormans, 2015). In the imitation approach, companies aim to mimic the features of conventional packaging (e.g., the transparency of plastic) and "hide" those typical of eco-materials (e.g., the opacity level of a biodegradable packaging). An example of this imitation approach is the new Coca-Cola bottle, that although partly made of plant materials, (PlantBottle® technology), looks identical to the conventional version (Magnier & Schoormans, 2015). In the food and packaging industry the imitation strategy often prevails and is becoming a common practice (Guillard et al., 2018; Sirviö et al., 2013) for two main reasons: 1) due to the recent technological progresses that enable production of sustainable packaging with a conventional look (e.g. transparent as plastic) (Magnier & Schoormans, 2015) and 2) due to the fear of a reduced consumer acceptance. Companies, for example, fear that consumers would not accept the opacity of a biodegradable packaging, distinct from the transparency of conventional plastic, associated with a fresh and trustworthy product (Billeter et al., 2012; Simmonds & Spence, 2017). While, on the one hand, this imitation practice prevents from potential negative associations of eco materials, on the other

[17] Described in the Wiley Encyclopedia of Packaging Technology as a look with a hint of grey, yellow or blue.

hand, it carries some disadvantages, as it risks to hide packaging cues that signal distinctiveness to consumers (Heidbreder et al., 2019; Magnier & Schoormans, 2015).

In the differentiation approach, instead, the distinctive sensory properties of eco materials are highlighted and exploited as differentiation tools (Azzi et al., 2012; Rettie & Brewer, 2000; Schoormans & Robben, 1997; Underwood et al., 2001), as "reminders for newness and distinctiveness" (Lindh et al., 2016a; Rundh, 2009, 2016). Research on new product development has highlighted the importance of detecting newness in a new product (Michaut, 2004; van Trijp & van Kleef, 2008), where change and surprise are two closely-related variables (Berlyne, 1960). A new and distinctive tactile element of a packaging, for example, might surprise consumers and make them realized that something in the packaging has changed (Chandon, 2013; Piqueras-Fiszman & Spence, 2011). A slightly atypical appearance can create a deviation from expectations, disrupt from consumer automated behaviour and catch consumer attention (Magnier & Schoormans, 2015; Pancer et al., 2017; Schifferstein et al., 2013; Steenis et al., 2017). The interruption of this automatic flow reminds consumers about the distinctiveness of the new packaging (Lindh et al., 2016a; Rundh, 2009, 2016) and provide the opportunity to create new associations (e.g., with sustainability) (Kurz et al., 2015; Verplanken & Wood, 2006; White et al., 2019).

4.2.2 Design elements as meaning providers for sustainability

Next to being "reminders", such distinctive sensory properties can be used as "meaning providers", aimed at making sustainability-related constructs more salient to consumers, activated in consumer mind and accessible for the subsequent perception process (Fishbein & Ajzen, 1977; Higgins, 1996; Olson, 1978; Steenkamp, 1990).

Packaging design elements like visual, haptic, auditory packaging properties can be defined as implicit cues, as they implicitly convey sustainability (Peters, 2016) through an associative inferential belief formation route (Fishbein & Ajzen, 1977; Lindh et al., 2016a; Steenis et al., 2017; Steenkamp, 1990). Through this inferential process, consumers draw inferences, by filling in missing information. Research has largely studied implicit packaging design elements, such as green colours (Parguel et al., 2015), rough surfaces (Labbe et al., 2013), natural design (Magnier & Schoormans, 2017), kraft

paper materials (Lindh et al., 2016a) as "meaning providers" for sustainability, as they can implicitly signal sustainability to consumers.

Which meaning consumers derive from packaging design depends on previously encountered associations and prior knowledge in consumer memory (Olson, 1978; Steenkamp, 1990). Some cues, such as a green colour or a natural graphic hold well embedded and learned associations with nature and environment (Pancer et al., 2017; Steenis et al., 2017), being inherently meaningful in signalling sustainability to consumers. On the contrary, other design cues, might be defined as "meaningless" in this regard: the noisy sound of PLA packaging, might not (yet) raise any association with the natural world, and might be unable to activate a sustainability related construct in consumer mind (Evans et al., 2020; Guillard et al., 2018; Krishna et al., 2017; Littel & Orth, 2013). Like the noisy PLA, associations around other new materials deserve further investigation (Biermann & Rau, 2020). Meaningless cues, as the noisy sound of PLA, can be "loaded" with meaning by, for example, an ecological claim that explicitly communicates the sustainability of the PLA packaging (Magnier & Schoormans, 2015).

Whereas implicit cues gain impact predominantly through an associative inferential route, explicit cues convey associations, impressions and meanings to consumers predominantly through an informational belief formation route (Fishbein & Ajzen, 1977; Steenkamp, 1990). Informational and verbal statements about packaging (as packaging labels and claims) can be defined as explicit cues, as they explicitly communicate the packaging's environmental friendliness. Consumers use explicit cues to form evaluations (belief) about the sustainability of packaged products, through a more deliberate, cognitive and informational-making process (Holbrook & Moore, 1981; Veryzer Jr & Hutchinson, 1998).

The functions of "reminders" and "meaning providers" of the implicit and explicit cues are not limited to the point of purchase, where they serve to draw attention and increase salience and perception of sustainability but extend beyond that. Despite the scarce attention to post-purchase and post-use behaviours (Bolderdijk et al., 2013; Klaiman et al., 2017; Steg et al., 2014), recent studies show that on-packaging explicit cues (e.g. logos and labels) (Borgman, 2018) or implicit design elements (e.g. environmentally friendly look) (Geiger, 2020) guide consumers towards more sustainable disposal

behaviour of packaging (Borgman, 2018; Geiger, 2020) and its content (Zeng et al., 2021).

4.2.3 The combination of design elements: a controversial effect

Implicit and explicit cues typically co-occur as meaningful parts of the design (van Ooijen et al., 2017) and might influence, in combination, sustainable consumer responses (Orth & Malkewitz, 2008). Although combining different sustainable design elements might be seen as a favourable option by companies (Bocken et al., 2016; Steenis et al., 2018), at a theoretical level, the effect of such combination is controversial. Traditional communication theories support the idea that increasing the number of arguments in a message increases its persuasive effect, either by providing individuals with more information or simply by triggering the inference "the more the better" (Eagly & Warren, 1976; Maddux & Rogers, 1980; Petty & Cacioppo, 1984). Following this view, the combination of eco explicit and implicit cues would increase the persuasive impact of the sustainability related message. As a result, consumers would be expected to perceive the packaging as more sustainable (Magnier & Schoormans, 2015) and behave accordingly in its disposal.

However, the theory on the embedding effect suggests that items may be valued more highly when presented singularly than when they are combined (Cummings, 1986; Kahneman & Knetsch, 1992; Mitchell et al., 1989). Drawing from this perspective, we could assume that combining explicit and implicit cues would not create additional effects in increasing sustainable responses (Irwin & Spira, 1997). More extremely, the combination of explicit and implicit design cues might even backfire and have a counterproductive effect. Research on "green consumer confusion", "green scepticism" and "greenwashing" suggests that overloading consumers with eco-design elements could make them question the product true sustainability (Aji & Sutikno, 2015; Magnier & Schoormans, 2015; Mitchell et al., 2005; Vincent-Wayne & Vassilios, 1999). Thus, following this research line, we could expect that over-stating or exaggerating the sustainability message, through the combination of eco-explicit and implicit cues, might negatively affect the sustainability perception of the packaging.

To conclude, existing theoretical perspectives offer contradictory predictions, one supporting the view that more cues strengthen consumers

responses regarding sustainability: "*the combination of eco explicit and implicit design cues increases sustainability salience, perception and sustainable (disposal) behaviour*" and another one in support to its opposite, that more cues actually harm (or do not lead to any increase in) consumer sustainable responses: "*the combination of eco explicit and implicit design cues decreases or leads to no increase in sustainability salience, perception and sustainable (disposal) behaviour"*.

The current research aims to shed light on this theoretical contradiction by identifying the conditions under which either of these perspectives is more dominant. We propose that the combination of implicit and explicit design elements improves sustainability communication if it functions as a meaningful reminder. First, packaging cues need to interrupt consumer automated behaviour to signal distinctiveness (reminder) and then they must re-store it to convey the intended meaning, i.e., sustainability (meaning provider).

4.2.4 Studies overview

Three studies tested the concept of meaningful reminder and the effect of the combination of explicit and implicit design cues on a different range of sustainable responses, as sustainability salience, perception and disposal behaviour. In study 1, we tested the general phenomenon, whether the combination of explicit and implicit design cues increases or decreases salience and perception of sustainability. After having provided evidence on this phenomenon through a lexical decision task, thought listing task and self-reported scale (study 1a), we replicated the findings with different stimuli (study 1b and study 1c). In study 2, we tested whether the general phenomenon depends on the implicit cues provided, and specifically on whether these might function as meaningful or meaningless reminders by themselves. In study 3, we tested whether the general phenomenon depends on the explicit cues provided and, specifically, on their ability to load a meaning to a (meaningless) implicit cue. In addition, study 3 tested whether the combination of implicit and explicit cues had an effect beyond salience and perception, on disposal behaviour of the packaging and its content.

4.3 Study 1

Data for study 1 a, b and c were collected together with those of study 2. Participants received 10-euro compensation after completion of all parts of the studies.

4.3.1 Methods study 1a

4.3.1.1 Participants and design

Two hundred and twelve Dutch participants (*M*age = 42.25, *SD* = 13.69; 55% females), recruited through a panel of a Dutch research centre (CSO), participated in a two (implicit cue: absent/present) by two (explicit cue: absent/present) between-subjects design. To have sufficient power (≥.80) to detect a medium effect size (f=0.25) at α = .05, a minimum sample size of 179 was calculated (G*Power 3) (Faul et al., 2007). Some more participants were recruited to compensate for Covid19 related no-show.

4.3.1.2 Stimuli

The stimulus material consisted of four different mock-ups of mono portion packaging for biscuits, one per experimental condition, created by graphic designers of the Dutch research institute of sustainable packaging (KIDV), within the European project MYPACK[18]. Each packaging consisted of a paper part containing two biscuits and of a plastic part. A fake brand "*Granny*" was created for this study and a label with the product information was printed on the back of the packaging to make the stimuli as realistic as possible (Table F.1, Appendix F, at the end of this chapter).

The control condition (implicit and explicit cues absent) consisted of a transparent mono portion packaging, mimicking conventional plastic. The implicit cue was manipulated through a rough tactile property, typical of some eco-materials, while the explicit cue consisted of the official European logo of compostable and biodegradable packaging and explanation of this material[19] (*figure 4.1*; table F.1, Appendix F).

[18] MYPACK is a European consortium of food and packaging companies and research institutes with the aim to develop and commercialize sustainable food packaging innovations.
[19] The explanation of the biodegradable and compostable material was formulated in collaboration with MYPACK packaging experts and material engineers and stated: "*This*

Control packaging | Implicit cue | Explicit cue | Combination

Figure 4.1: Stimuli material for study 1a (front of packaging).

4.3.1.3 Procedure and measures

After being welcomed in the experimental room, participants read the Covid19 guidelines for a safe experimental procedure, approved by an ethical committee, and signed an informed consent. They were then randomly assigned to one of the 4 conditions.

Lexical decision task

To measure whether implicit and explicit packaging cues enhance salience of sustainability, and specifically whether these cues spontaneously activate the sustainability related construct in consumers' mind, participants first conducted a lexical decision task (LDT). The lexical decision task represents an implicit method to measure the activation of knowledge that people may not be consciously aware of (Fishbach & Dhar, 2005; Förster et al., 2005; Schvaneveldt & Meyer, 1973; Slabu & Guinote, 2010; Wilcox et al., 2009). Based on the LTD assumption that reactions to words are facilitated by accessibility, response time to sustainability words in the LDT indicated higher accessibility and salience of the sustainability related construct. As cover story for the LDT, respondents were informed that the task on the Dutch language would support their focus on the packaging evaluation afterwards.

After a LDT practice test of 10 trials repeated twice, participants were submitted to the priming phase, in which they were provided with the biscuit package of their condition and asked to experience and interact with

packaging is made from starch, a biodegradable material. In a compost plant it will turn into compost and organic matter" (translation from the original Dutch).

it[20]. Then, the actual lexical decision task began. Participants were asked to indicate as quickly and accurately as possible whether a letter string appearing on a computer screen was an existing word, by pressing ''yes'' or ''no'' on the keyboard (Z for yes and M for no) (Holland et al., 2005). Across two cycles of 24 randomized trials, 12 non-words[21] and 12 real Dutch words (3 target and 9 control words) appeared at the centre of the screen for 2 seconds, after a fixation dot. Dutch target words (sustainability related) comprised: *duurzaam* (sustainable), *natuur* (nature) and *milieu* (environment). Words and non-words were derived from the Dutch Lexicon project (Brysbaert et al., 2016), having the same number of letters and syllables for target words, control words and non-words (Slabu & Guinote, 2010) and were pre-tested (table G.1, Appendix G).

Thought listing task

After the LDT, participants were asked to re-experience the biscuit packaging which was still in front of them and to report their thoughts and feelings while experiencing the packaging[22]. This "thought listing task" (Edell & Keller, 1989; Shiv et al., 1997; Shiv & Fedorikhin, 1999) was used to identify the frequency of sustainability related thoughts, to supplement the LDT measure for salience of sustainability.

Sustainability perception was then measured on a single item seven-point scale ranging from 1 (very unsustainable) to 7 (very sustainable): "*To what extent is this (biscuits) packaging sustainable to you?".* Respondents were thanked and introduced to study 1b.

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[20] "*Please take in your hands the biscuits packaging you have on your desk. Interact with it as much as you can: look at it carefully, touch it, feel it, turn it around. Use all your senses to have a good impression of it. Think on the thoughts and feelings that go through your mind while experiencing this packaged product*." (translation from the original Dutch).

[21] Non-words are meaningless letter combinations that follow syntactic rules of existing words in having pronounceable syllables.

[22] "*Which thoughts and feelings go through your mind while experiencing (looking at, touching, holding etc..) this packaged product? Please describe them here as complete and elaborate as possible*" (translation from the original Dutch).

4.3.2 Analysis plan

An index of sustainability salience was computed from lexical decision task data as the difference between average response latency for control words and target words. The reaction time from trials where the stimulus was not correctly identified was excluded (Greenwald et al., 2003), as well as the data of the practice block. A higher score on the index indicates that sustainability is more salient (Förster et al., 2005). An ANOVA was conducted to test the effect of implicit and explicit cues on salience and perception of sustainability.

Sustainability salience from the thought listing task was analysed using the number of sustainability-related thoughts and feelings. Text was coded by two coders not involved with the study setup using a predefined code book including the following codes: "sustainability" (e.g. natural, ecological, good for the environment etc.), "sustainability negative" (e.g. too much packaging, unsustainable etc.), "product quality", "convenience", "bad packaging quality", "hedonic", "hedonic negative", "novelty", "sensory properties" and "scepticism" (no trust/belief over the sustainability of the packaging); table G.2, in Appendix G, provides further details). If respondents mentioned more than one thought/feeling related with the same code, this was counted one time only. Coding was checked by the first author and differences were solved in mutual agreement. Frequencies of each code were calculated and analysed through crosstabs chi square and z-test with Bonferroni adjusted p-values to compare conditions.

4.3.3 Results study 1a

4.3.3.1 Effect of explicit and implicit cues on salience of sustainability

Lexical decision task

The lexical decision task showed no main effect of implicit cue ($F(1, 208) = 0.04$, $p = .84$) nor of explicit cue ($F(1, 208) = 0.37$, $p = .54$) but did suggest a marginally significant interaction between implicit and explicit cues ($F(1, 208) = 3.44$, $p = .06$, part. $\eta^2 = .02$) on sustainability salience, to the extent that implicit and explicit cues work against each other.

The sustainability related construct was less salient for the packaging with both implicit and explicit cues (M = 74.36) as compared to those with only explicit (M = 94.21) or implicit cues (M = 89.34) (*table 4.1*, *figure 4.2* panel a).

Table 4.1: Mean reaction time (RT) (SD) for target and control words and index of salience of sustainability across conditions (in milliseconds).

		Implicit cues absent	Implicit cues present
Explicit cue absent		n=52	n=53
	RT target words	689.69 (176.32)	723.60 (216.50)
	RT control words	754.25 (140.97)	812.95 (220.70)
	Index of salience of sustainability	64.57 (99.1)[ab]	89.34 (88.28)[a]
Explicit cue present		n=50	n=56
	RT target words	688.50 (138.79)	660.33 (128.41)
	RT control words	782.71 (110.68)	734.69 (111.49)
	Index of salience of sustainability	94.21 (96.17)[a]	74.36 (63.2)[b]

Values sharing the same superscript letter are not significantly different at the .05 level

Thought listing task

The results from the thought listing task showed that sustainability was more salient to consumers when the explicit cue was present than absent (*table 4.2*). The combination of explicit and implicit cues led to no increase in sustainability salience when explicit cues were already present. Thus, comparable results were obtained measuring salience of sustainability through an implicit (LDT) and explicit self-reported method (thought listing task): the combination of explicit and implicit cues did not lead to any increase in sustainability salience (*figure 4.2*, panel b) and can even have a counterproductive effect (*figure 4.2*, panel a).

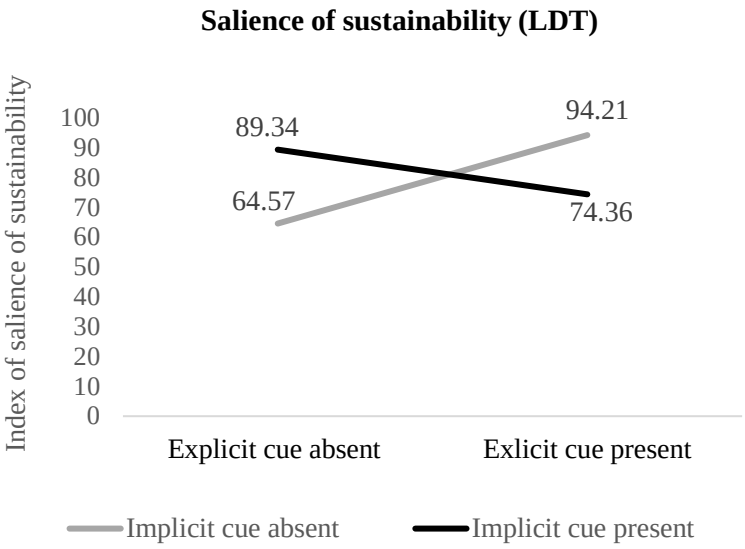
Table 4.2: Frequency of the sustainability related thought (coded as "sustainability") across conditions.

	Control (n=53)	Implicit cue present (n=53)	Explicit cue present (n=48)	Combination (n=57)	χ^2 (df=3); p value
Frequencies	7[a]	9[a]	22[b]	27[b]	24.87
Proportion frequencies/total	.13	.17	.46	.47	p<.01

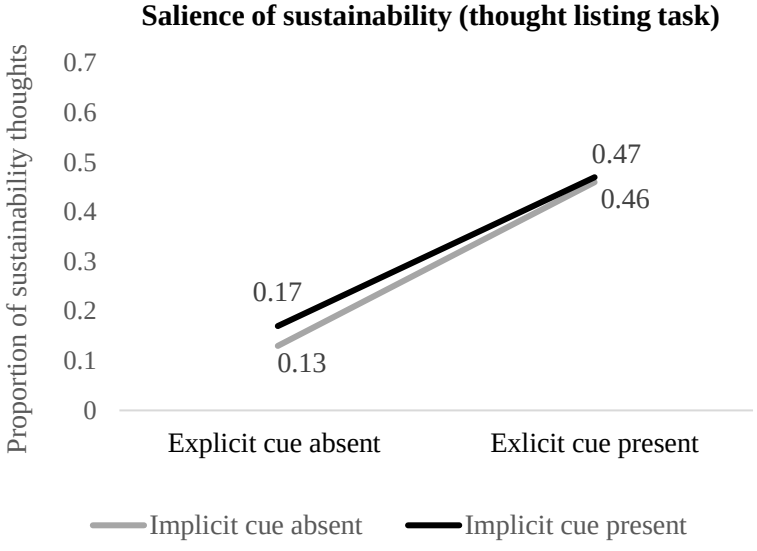
Columns sharing the same superscript letter are not significantly different at the .05 level (crosstabs with pairwise z-test Bonferroni corrected).

4.3.3.2 Effect of explicit and implicit cues on perception of sustainability

An ANOVA showed a significant main effect of explicit cue ($F(1, 208) = 66.45$, $p < .01$, part. $\eta^2 = .24$), no significant effect of implicit cue ($F(1, 208) = 0.04$, $p = .85$) and a significant interaction effect ($F(1, 208) = 3.84$, $p = .05$, part. $\eta^2 = .02$) on sustainability perception. Subsequent simple effects analysis showed that in the absence of implicit cues, consumers perceived the biscuits packaging as more sustainable when explicit cues were present ($M = 5.80$, $SD = 1.22$) rather than absent ($M = 3.75$, $SD = 1.44$; $F(1, 208) = 49.26$, $p < .01$, part. $\eta^2 = .12$). In the presence of implicit cues, consumers also perceived the biscuits packaging as more sustainable when explicit cues were present ($M = 5.44$, $SD = 1.49$) rather than absent ($M = 4.19$, $SD = 1.66$; $F(1, 208) = 19.92$, $p < .01$, part. $\eta^2 = .09$). The fact that consumers rated a packaging with both explicit and implicit cues as less sustainable (M = 5.44) than a packaging with explicit cue only (M = 5.80) might suggest a rather weak efficacy of combining explicit and implicit cues (*figure 4.2*, panel c).


Salience of sustainability (LDT)
Index of salience of sustainability
100
90
80
70
60
50
40
30
20
10
0
89.34
94.21
64.57
74.36
Explicit cue absent
Exlicit cue present
Implicit cue absent
Implicit cue present

a


Salience of sustainability (thought listing task)
Proportion of sustainability thoughts
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.47
0.46
0.17
0.13
Explicit cue absent
Exlicit cue present
Implicit cue absent
Implicit cue present

b

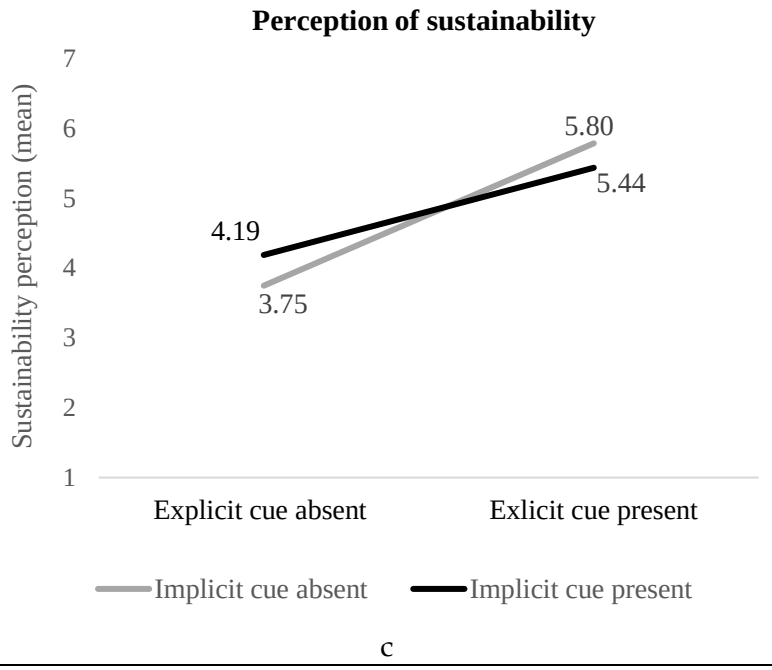


Figure 4.2: Sustainable responses to the biscuit packaging measured as: salience of sustainability through the lexical decision task (panel a), salience of sustainability through the thought listing task (panel b) and self- reported sustainability perception (panel c).

4.3.4 Studies 1b and 1c: replications

To test for robustness of the results, study 1a was partially replicated with different product-packaging combinations and implicit and explicit cues. In study 1b, consumers were shown a salad packaging (flexible bag) with a blow device technology which keeps the atmosphere inside the packaging constant and maintains the salad fresher for longer, reducing food waste. In study 1c, consumers were confronted with a rigid baby food jar made of recycled material. Study 1b and 1c had identical measures, design and procedure as study 1a, except for omitting the lexical decision task. Explicit cues consisted of the logo and explanation of the blow device (1b)[23] and

[23] Explanation of the blow device: "*This packaging includes a device that controls the atmosphere inside the packaging, thus it keeps the product breathing and extends its shelf life to reduce its potential food waste*".

recycled material (1c)[24]. Implicit cues were represented by a graphic for the blow device suggesting its function (a lady doing breathing exercises implying that the salad could "breath better") (1b) and by a heterogeneously coloured, non-uniform look, typical of recycled plastics (1c) (pictures in tables F.2 and F.3, Appendix F).

4.3.5 Results study 1b and 1c

Salience of sustainability

Results of study 1b and 1c showed a similar pattern to study 1a: sustainability was more salient when explicit cues were present rather than absent and the combination of implicit and explicit cues did not lead to any increase in sustainability salience (*table 4.3*). Content analysis of the thoughts listed in study 1b gives also some insights on the "thoughts/feelings of scepticism" towards the overall packaged product. Relatively more consumers mentioned thoughts related to scepticism when both implicit and explicit cues were present (n = 14), than in other conditions (control = 1, implicit = 8, explicit = 6; $\chi^2 = 11.93$; p = .08).

Table 4.3: Frequency of the sustainability related thought (coded as "sustainability") for study 1b and 1c.

	Frequencies	Control (n=53)	Implicit cue (n=53)	Explicit cue (n=48)	Combination (n=57)	χ^2(df=3); p value
Study 1b	*Sustainability*	15[a]	12[a]	31[b]	31[b]	25.92, p<.01
Study 1c	*Sustainability*	6[a]	8[a]	28[b]	38[b]	55.46, p<.01

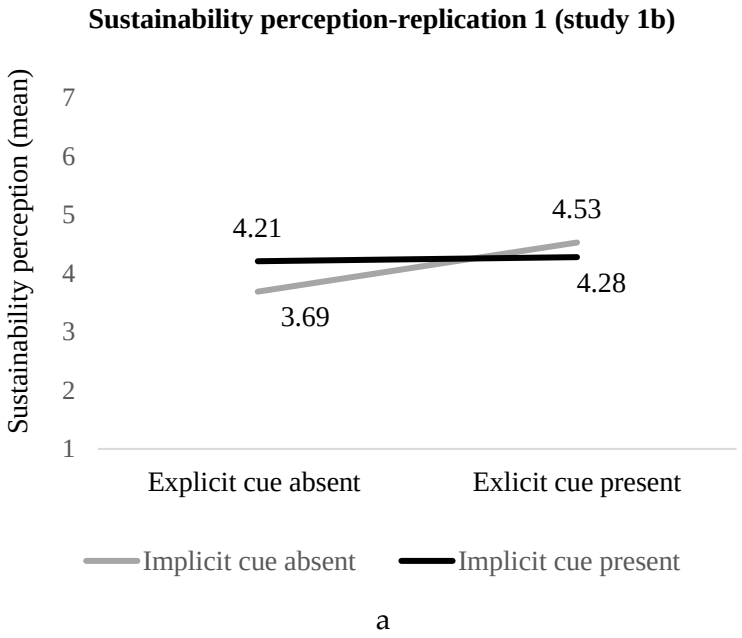
Columns sharing the same superscript letter are not significantly different at the .05 level (Crosstabs with pairwise z-test Bonferroni corrected).

[24] Explanation of the recycled material: *"This packaging is made with recycled material. The material has been processed to be re-used for a new life in this packaging"*. As in study 1a graphics and mock-ups were designed and developed within MYPACK.

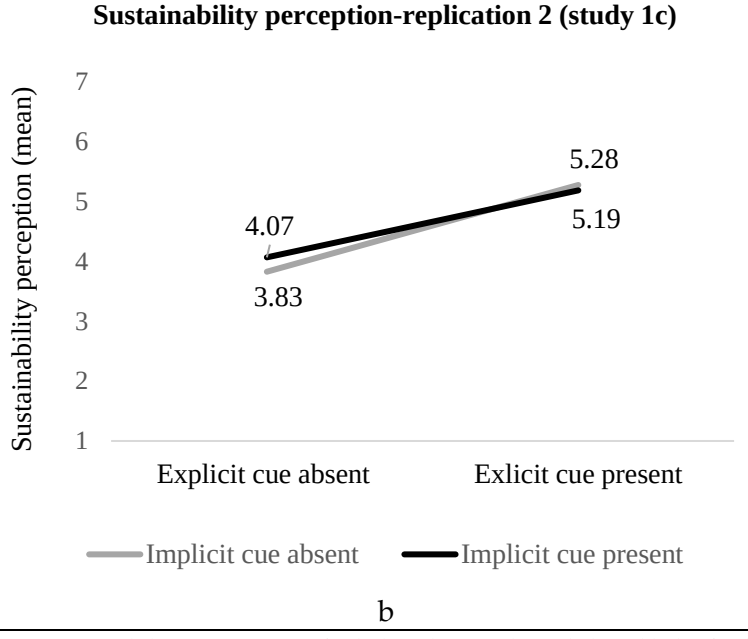
Perception of sustainability

Results of the study 1b showed a significant main effect of explicit cues on sustainability perception, $F(1, 208) = 4.02$, $p = .05$, part. $\eta^2 = .02$, and a trend for the interaction effect, $F(1, 208) = 2.83$, $p = .09$, part. $\eta^2 = .01$. The effect of implicit cues was not significant, $F(1, 208) = 0.33$, $p = .57$.

The results of study 1c showed a significant main effect of explicit cues on sustainability perception, $F(1, 208) = 43.314$, $p < .01$, part. $\eta^2 = .17$. Neither the main effect of implicit cues, $F(1, 208) = 0.15$, $p = .70$, nor that of the interaction, $F(1, 208) = 0.74$, $p = .39$, was significant. This provides partial replication of study 1a, as 1) consumers perceived the packaging as more sustainable when explicit cues were present, 2) implicit cues did not have any effect and 3) the combination of explicit and implicit cues either did not add any effect (study 1c) or, as in study 1a, diminished it (study 1b) (*figure 4.3*, panel a and b).



a



b

Figure 4.3: Sustainability perception of salad packaging (panel a) and baby food packaging (panel b).

4.3.6 Discussion study 1a, 1b and 1c

Study 1 showed consistent and robust effects across a diverse range of stimuli, in terms of packaging technologies for different implicit (rough tactile property, graphic for the blow device and non-uniform look) and explicit cues (logos and explanations of biodegradable and compostable materials, blow device technology and recycled materials) and different products (biscuits, salad, baby food). In addition, the main conclusions are demonstrated across different measures: 1) the lexical decision task that measures the activation of constructs that consumers might not be aware of, 2) the thought listing task that let consumers spontaneously report their thoughts and feelings while experiencing the packaging, and 3) a Likert scale for sustainability perception. Findings from all replications and measures showed that salience and perception of sustainability is significantly affected by explicit cues. The implicit cues that we have tested seem not to affect these responses. More importantly, looking at the interaction effect, results are in support of the "more is enough" and "more is less" assumption. Combining explicit and implicit cues does not increase sustainability salience and perception and may even backfire, arousing, in some cases, scepticism towards the packaging. This might be explained by the phenomenon defined as "green overload confusion" (Aji & Sutikno, 2015; Magnier & Schoormans, 2015; Mitchell et al., 2005; Vincent-Wayne & Vassilios, 1999). Research on "green consumer confusion" and "green scepticism" suggests that over-emphasizing the sustainability message (e.g., in our case, through the combination of eco implicit and explicit cues) makes consumers question whether the product is actually sustainable or the opposite. The reasons why an overload of information generates confusion might be due to the strong associations between sustainability and simplicity (Oates et al., 2008). Sustainability constructs are indeed often associated with an idea of simplicity, with the reduction or avoidance of superfluous design elements (Granato et al., 2022b). Thus, an overload of design elements might lead, through green confusion, to negative perceptions about the environmental features.

To further investigate the effect of combining explicit and implicit packaging cues on sustainable responses and specifically, whether this effect depends on the specific implicit and explicit cues provided, we conducted a study 2.

While keeping explicit cues constant, study 2 extends study 1, by investigating how different implicit cues show different levels of meaningfulness. Therein, we assume that some implicit cues, for example a green colour, may activate sustainability related thoughts independently from explicit cues, as they already hold a well embedded and learned association with nature and environment. While these cues may be inherently meaningful in signalling sustainability, others may not. Such meaningless cues might thus benefit most from adding explicit cues. In study 2, we test whether explicit cues represent more effective "meaning providers" if combined with meaningless rather than meaningful implicit cues.

4.4 Study 2

4.4.1 Methods

4.4.1.1 Participants, design and stimuli

The same participants that participated in study 1 were randomly re-allocated to one of the two conditions of a two between (explicit cue: absent/present) by six within (implicit cue) subject design. The six levels of implicit cues were: (1) absent (control package), (2) sound, *a noisy loud sound*, typical of the biobased polylactic acid material (PLA), (3) opaque, *a cloudy, non-transparent look*, typical of biodegradable and compostable plastics, (4) touch, a somewhat *sticky tactile property*, typical of water-soluble films and recycled plastic (PET), (5) look, a *recycled/kraft visual*, typical of recycled paper materials, (6) colour, a *green colour*. All the packaging's were identical to the control packaging except for the single implicit variation suggested by the name. We expected these variations to represent meaningful or meaningless reminders.

Explicit cues consisted of two different logos and explanations to avoid presenting respondents six packages with the same explicit cue (but different implicit cues). The logo and explanation of biodegradable and compostable material and the logo and explanation of recycled materials were both used; counterbalanced across participants in the between group conditions (see table H.1, Appendix H for the stimuli).

4.4.1.2 Procedure and measures

Respondents were informed that different European companies had developed new mono-portion packaging for on-the-go biscuits and that they wanted to know how consumers would evaluate them. Respondents were confronted with six biscuits packaging, one after each other. To be sure respondents experienced each of the six packages one by one, packages were provided in a drawer cabinet presenting the opening sequences. Respondents were instructed to experience the packaging as much as possible and to reply to some questions measuring salience and perception of sustainability[25]. Respondents then completed a memory recall task to test whether they noticed the packaging manipulations (Barlow & Wogalter, 1993; Raghubir & Valenzuela, 2006; Shaw et al., 2000)[26]. Results showed that the sensory aspects of the packaging (e.g., visual, tactile, auditory elements) were frequently mentioned by consumers (n = 161), therefore noticed, remembered and functioning as reminders for newness and distinctiveness.

4.4.2 Results

4.4.2.1 Effect on salience of sustainability: meaningless or meaningful cues

The results from the thought listing task showed that different implicit cues did not make sustainability equally salient to consumers. In the condition without explicit cues (n = 107), the implicit cues of the noisy sound (n = 9) and the sticky touch (n = 6) did not raise more sustainability related thoughts than the control condition (n = 8). Thus, these implicit cues were meaningless in signalling sustainability to consumers. More consumers mentioned sustainability related thoughts when they experienced the opaque packaging (n = 21), the packaging with a recycled/kraft look (n = 31) and the packaging with the green colour (n = 35). These implicit cues were, thus, inherently meaningful in signalling sustainability.

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[25] Salience of sustainability was measured through the thought listing task as in study 1. To limit repetition, in this study, participants were asked to report thoughts and feelings using key words, rather than fully elaborating. *"Write here your thoughts and feelings that go through your mind while experiencing this packaged product. You can use key words"*. Perception of sustainability was measured identical to study 1.

[26] This was measured through the open question:" You *have just evaluated 6 biscuits packaging one after the other. If you close your eyes, which element of the packaging you remember the most?"*.

When explicit cues were added to meaningless implicit cues, a higher proportional increment was observed on salience of sustainability (sound x2.67, touch x4.00), compared to when explicit cues were added to already meaningful cues (opaque x1.95, look x1.77). Combining explicit cues with the meaningful cue of green colour even led to a decrease (of x0.66) in salience of sustainability (*table 4.4*).

4.4.2.2 Combining explicit cues to meaningless/meaningful implicit cues: effect on sustainability perception

A mixed ANOVA with implicit cues as within subject variable and explicit cues as between subject variable was conducted, to test the effect of the combination of cues on sustainability perception. Results showed a main effect of implicit cues, $F(5, 206) = 12.82$, $p < .01$, part. $\eta^2 = .06$, a main effect of explicit cue, $F(1, 208) = 67.3$, $p < .01$, part. $\eta^2 = .24$, and an interaction effect between implicit and explicit cues, $F(1, 206) = 8.85$, $p < .01$, part. $\eta^2 = .04$, on sustainability perception. Results from the pairwise comparisons showed that meaningful implicit cues significantly increased sustainability perception of the packaging (opaque = 3.98, look = 3.89, green colour = 4.42) compared to the control packaging (mean = 3.49; all p values <.05). Meaningless implicit cues (sound = 3.26, touch = 3.62), instead, did not differ from the control condition (mean = 3.49; all p values >.05), aligning with the results on salience of sustainability (*table 4.4*).

Results also showed that combining an explicit cue to a meaningless reminder (sound and touch) led to a higher increment on sustainability perception (sound = +1.37, touch = +1.26) compared to when this was added to an already meaningful reminder (opaque = +1.05, green colour = +0.53). The implicit cue of natural look, although a meaningful cue, still benefited from the addition of explicit cues (+1.61) (*table 4.4*, for visualization see figure H.1 Appendix H).

Table 4.4: Effect of implicit and explicit cues on salience of sustainability (frequencies) and perception (mean, SD).

Measure	Explicit/ implicit	Meaningless			Meaningful		
		Absent	Sound	Touch	Opacity	Look	Colour
Salience of sustainability	Absent (n=107)	8	9	6	21	31	35
Frequencies	Present (n=105)	58	24	24	41	55	23
	Proportional increment	x7.25	x2.67	x4.00	x1.95	x1.77	x0.66
Sustainability perception M(SD)	Absent (n=107)	3.49 (1.55)[a]	3.26 (1.49)[a]	3.62 (1.63)[a]	3.98 (1.60)[c]	3.89 (1.53)[b]	4.42 (1.74)[d]
	Present (n=105)	5.41 (1.45)[c]	4.63 (1.57)[a]	4.88 (1.52)[ab]	5.03 (1.61)[b]	5.50 (1.41)[c]	4.95 (1.62)[ab]
	Absolute increment	+1.92	+1.37	+1.26	+1.05	+1.61	+0.53

Columns sharing the same superscript letter are not significantly different at the .05 level (Crosstabs with pairwise z-test Bonferroni corrected). Proportional increment represents of how many times the value increased from explicit cue absent to present. Absolute increment represents of how many points the value has increased in the 1-7 scale.

4.4.3 Discussion study 2

Study 2 demonstrated the different nature of implicit cues, as inherently meaningless or meaningful reminders. Some implicit cues, as green colour, recycled/craft look, and opaque material, carry inherent "meaningfulness" in relation to sustainability, while others, as sound and touch, lack such meaningfulness, despite being noticed by consumers and functioning as reminders for newness and distinctiveness. Adding an explicit cue to a meaningless reminder results in a relatively large increase in sustainability perception of the packaging, thus supporting the assumption of "more is more". However, combining an explicit cue with an already meaningful reminder (e.g., opaque packaging) lead to a much smaller increment, or even to a decrease in sustainable responses (as for the green colour combined to an explicit cue). This might still be explained by the "green overload confusion" as in study 1a.

Building on study 1 that provides a first insight into the general phenomenon (more is more, or more is less?), study 2 investigated the nature of implicit cues, while keeping explicit cues constant. Study 3 further extends this by exploring the effect for different explicit cues, while keeping implicit cues constant. We assume that the effect of the combination of implicit and explicit cues depends on the ability of the explicit cue to create an association between the (meaningless) implicit cue (e.g., the distinctive sound or tactile property of eco materials) and the improved sustainability of the packaging. If such association cannot be created, the explicit cue is unable to transfer a meaning to the implicit cue, which remains meaningless. Hence, for those implicit cues that do not hold any a priori association with sustainability, the ability of the explicit cues to transfer this missing link might be essential to create a meaningful reminder. We further extend studies 1 and 2, by replacing on-packaging logos and labels with information from external sources (a packaging expert) and by measuring sustainable disposal behaviour.

4.5 Study 3

4.5.1 Materials and methods

4.5.1.1 Participants and design

One hundred and seventy-one Dutch participants (*M*age = 38.68, *SD* = 15.09; 63% female), recruited through a Dutch consumer panel, took part in a twenty-minute experiment for 7.50-euro compensation. After giving informed consent, participants were randomly allocated to one of the conditions of a three between (explicit information: none/non-associative/associative) by two within (implicit cue: meaningless/meaningful) subject design.

4.5.1.2 Stimuli

Implicit cues were manipulated by four different biscuits packaging, that represented meaningless (sound or touch) and meaningful (opacity or kraft look) cues, based on study 2[27]. Packages were identical to those in study 2 and labelled with the participant number. Explicit information was manipulated by a video recording. In a professional video setting, an actor

[27] The green colour was not used, as it is not an intrinsic property of sustainable packaging.

portrayed a packaging expert/material engineer, in a lab coat in his laboratory.

In the condition "no explicit information", the packaging expert gave no information on the sustainability of the packaging (baseline video), stating (translated from the original Dutch): "*Hello, my name is Michiel van der Kamp and I am a materials engineer. For many years, together with [blinded for review] University and the National Research Institute of packaging we have been researching new materials for food packaging. We have developed new packaging materials for example for biscuit products, such as these ones".*

In the "non-associative explicit information" condition, the packaging expert continued by explaining the sustainability of a packaging made of recycled material, including disposal instructions: "*These packages are made of recycled material. A material can be recycled if we separate this packaging from the rest and dispose of it with plastic waste" "A recycled material is basically a material that has been processed* ***to be re-used and function as a new packaging****".* In this condition, the information provided is defined as "non associative" as it explains the packaging technology (what recycled packaging means) without creating any association between the sensory properties of recycled materials (e.g., a distinctive look than conventional plastic) and their enhanced sustainability.

In the "associative explicit information" condition, instead, the packaging expert explains the packaging technology by providing a link, an association between the sustainability of the recycled packaging and its different sensory properties. Thus, the sustainability meaning is transferred and loaded to the implicit cues. After the disposal instructions, the video of this condition continued as: *A recycled material is basically a material that has been processed* ***and therefore, can have different sensory features than conventional packaging, such as a different appearance, colour, sound or tactile sensation****".*

Manipulations were pre-tested[28]. In the main study, on a seven-point scale, respondents evaluated the information as understandable (M = 6.27, SD = 1.12) and realistic (M = 5.67, SD = 1.24). An attention-check also confirmed

[28] The text of the speech of the packaging expert was checked with a small sample of consumers to verify whether 1) information on the sustainability of the packaging was provided 2) information created a link between the sensory properties and sustainability.

that participants paid attention to the video and remembered specific elements of the experts' speech.

4.5.1.3 Procedure and measures

Participants took their places in a testing booth, with a computer, a pair of headphones, a doggy bag and a tray with two packages: one with a meaningless implicit cue (sound or touch) and another one with a meaningful implicit cue (opacity or look). Participants were first asked to briefly experience both packages and to watch a video with the explicit information of their condition. Then, they were instructed to re-experience the packages, this time more deeply and one by one, starting with package 1 (meaningless implicit cue) and to reply to some questions measuring sustainability perception and purchase intention for that packaging. Then, respondents experienced package 2 (meaningful implicit cue) and replied to the same questions. Sustainability perception was measured identical to study 1 and 2. Purchase intention was measured through: "*To what extent would you buy this packaged product*?", on a seven point scale from 1 (very unlikely) to 7 (very likely) (Dodds et al., 1991).

A filler task was included to ensure that both packages were opened and emptied before measuring disposal behaviour. Participants were asked to open the packages (starting from package 1), taste the biscuits, evaluate their taste and report their thoughts and feelings (thought listing task identical to study 1 and 2). This was repeated for packaging 2. Participants then completed a three item 7-point scale on environmental concern (1 = completely agree, 7 = completely disagree) (Cervellon, 2012)[29] and indicated whether they had left-over biscuits or if they had eaten them all[30]. Finally, respondents were requested to empty their desk to follow Covid19 measures. They could use a doggy bag to take home left-over biscuits or throw them away on their way out. A doggy bag, labelled with the respondent's code, was used to measure food waste behaviour (de Visser-Amundson, 2020). Participants were asked to dispose the empty packaging

[29] *To what extent do you agree with the following statements? Indicate per statement. 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."*

[30] *Have you eaten all the biscuits? (yes/no).*

in a bin station consisting of two sets of four bins (organic, paper, plastic and general), placed towards the exit (figure I.1, Appendix I). Participants were unaware that this formed part of the experiment.

4.5.1.4 Analysis plan

Thoughts and feelings reported by respondents were analysed as in study 1 and 2 (details in table I.1, Appendix I). Disposal behaviour of the packaging was analysed by examining the garbage. The code "sustainable behaviour" was assigned if 1) participants had disposed of the paper inner part and plastic outside part of the packaging separately, and 2) respondents had sustainably disposed the recycled plastic packaging in the plastic bin (sorting and recycling) (Geiger, 2020). Otherwise, the code "unsustainable disposal behaviour" was attributed. Data were analysed with frequency analysis and binary logistic regressions to test effects of non-associative and associative information against the baseline "no explicit information", controlled for environmental concern.

Sustainable behaviour for biscuits was assessed using a doggy bag as proxy for avoiding waste (Stöckli et al., 2018). If respondents did not use the doggy bag, although they had some left-over biscuits, this was classified as "unsustainable behaviour regarding the biscuits". Otherwise, as sustainable behaviour.

4.5.2 Results

4.5.2.1 Salience of sustainability

Results from the thought listing task showed that more consumers mentioned sustainability related thoughts with the meaningful implicit cue (opacity or look; n = 45), than with the meaningless implicit cue (sound or touch; n = 22; $\chi^2(1) = 9.82$, $p < .01$). This is in line with study 2, indicating that opacity and kraft look represent meaningful implicit cues. Similarly, consumers thought more about the unsustainable aspects of the packaging (e.g., "too much material", "bad for the environment") for meaningless implicit cues (n = 26), than meaningful (n = 14), ($\chi^2(1) = 4.08$, $p = .04$; *table 4.5*). These thoughts decreased for associative explicit information (n = 7), compared to non-associative (n = 14) or none (n = 19), $\chi^2(2) = 6.17$, $p = .05$.

In addition, results from the content analysis showed that fewer consumers mentioned thoughts related to scepticism towards the packaging when associative explicit information was provided (n = 5), compared to non-associative (n = 12) or no information (n = 14), $\chi^2(2) = 4.75$, $p = .09$ (*table 4.5*).

Table 4.5: Frequencies of the thoughts related to the sustainability of the packaging (coded as "sustainability"), to the unsustainable aspects of the packaging (coded as "sustainability negative") and feelings of scepticism (coded as "scepticism").

	Explicit info/ implicit cues	None (n=57)	Non-associative (n=57)	Associative (n=57)	Total	χ^2(df), p value
Sustainability	Meaningful (N=171)	12	20	13	45[a]	Implicit $\chi^2(1)=9.82$, p<.01
	Meaningless (N=171)	6	7	9	22[b]	
	Total	18[a]	27[a]	22[a]		Explicit $\chi^2(2)=2.26$, p=.32
Sustainability negative	Meaningful (N=171)	7	4	3	14[a]	Implicit $\chi2(1)=4.08$, p=.04
	Meaningless (N=171)	12	10	4	26[b]	
	Total	19[a]	14[a, b]	7[b]		Explicit $\chi^2(2)=6.17$, p=.05
Scepticism	Meaningful (N=171)	4	4	1	9[a]	Implicit $\chi2(1)=6.00$, p=.01
	Meaningless (N=171)	10	8	4	22[b]	
	Total	14[a]	12[a]	5[a]		Explicit $\chi^2(2)=4.75$ p=.09

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 Bonferroni corrected).

4.5.2.2 Effect on sustainability perception

A mixed ANOVA showed a significant main effect of implicit cues, $F(1, 168) = 30.86$, $p < .01$, part. $\eta^2 = .16$ and explicit information, $F(1, 168) = 3.60$, $p = .03$, part. $\eta^2 = .04$, on sustainability perception. In line with study 2, participants perceived the packaging with meaningful implicit cues as more sustainable ($M = 4.82$, $SD = 1.42$) than with meaningless implicit cues ($M = 3.99$, $SD = 1.52$). The results also demonstrated that consumers perceived the packaging

as more sustainable when associative explicit information was provided (M = 4.68, SD = 1.46) rather than non-associative (M = 4.40, SD = 1.41) or none (M = 4.13, SD = 1.48).

Although no significant interaction effect between the implicit cues and explicit information was found ($F(1,168) = 1.08$, $p = .34$), a pairwise comparison analysis suggested that, in line with study 2, explicit information has more effect for meaningless rather than meaningful reminders. Moreover, associative explicit information significantly increased sustainability perception of the packaging with meaningless implicit cues (M = 4.33, SD = 1.56), compared to when no explicit information was provided (M = 3.56, SD = 1.58; $p = .01$). Associative explicit information did not increase the sustainability perception of the packaging with meaningful implicit cues (*figure 4.4*, panel a).

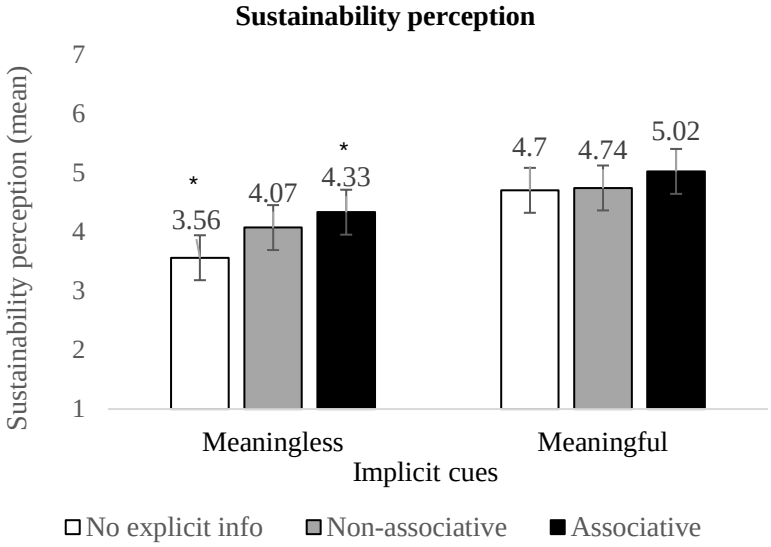
For purchase intention, a significant main effect of implicit cues was found, $F(1,168) = 5.80$, $p = .02$. No main effect of explicit information ($F(1, 168) = 0.63$, $p = .53$) nor an interaction ($F(1, 168) = 0.47$, $p = .63$) was observed. Pairwise comparisons showed a similar trend: when associative explicit information was provided, consumers were more willing to purchase the packaged product with meaningful (M = 4.82, SD = 1.28) rather than meaningless cue (M = 4.33, SD = 1.64; $F(1, 168) = 3.67$, $p = .06$).

4.5.2.3 Effect on disposal behaviour

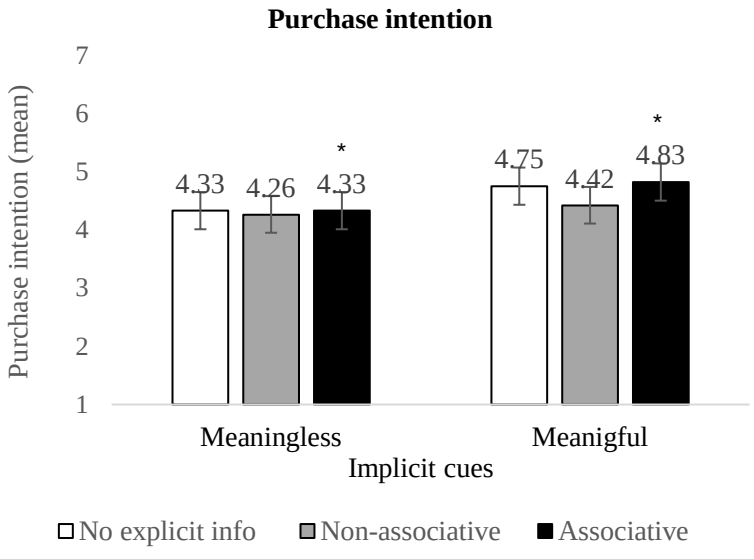
A logistic regression showed no effect of non-associative information on disposal behaviour of the packaging with meaningless and meaningful cue but a significant effect of associative information. Environmental concern, as covariate, had a marginally significant effect on disposal behaviour (*table 4.6*). Consumers behaved significantly more sustainably in disposing the packages when associative information was provided rather than non-associative or none, $\chi^2(2) = 10.93$, $p < .01$, independently from the implicit cues (meaningless/meaningful), $\chi^2(1) = 0.64$, $p = .42$ (*figure 4.4*, panel c). For the food waste behaviour, no differences were observed across conditions, $\chi^2(2) = 1.82$, $p = .40$.

Table 4.6: Effect of non-associative and associative explicit information on disposal behaviour of the packaging compared to the "no explicit information" condition (baseline). Effect controlled for environmental concern.

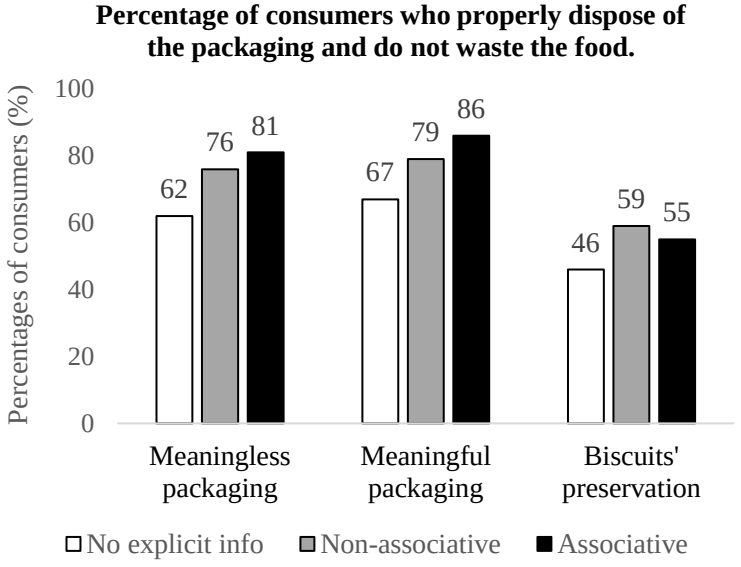
Dependent variables	Meaningless implicit cue					Meaningful implicit cue				
	β	S.E.	Wald	df	p	β	S.E.	Wald	df	p
Non-associative	.65	.44	2.20	1	.14	.60	.44	1.90	1	.17
Associative	.98	.46	4.65	1	.03	1.13	.48	5.54	1	.02
Environmental concern	.26	.14	3.21	1	.07	.03	.15	3.96	1	.05
Constant	-.11	.65	.03	1	.09	-.03	.66	.003	1	.96



a



b



c

Figure 4.4: Sustainability perception (panel a), purchase intention (panel b; columns with the asterisk show statistical significance between each other. Error bars indicate 95% confidence interval) and sustainable behaviour regarding the packaging and its content (panel c).

4.5.3 Discussion study 3

Study 3 showed that explicit information best serves meaningless reminders, reconfirming the results of study 2 and providing additional evidence on the function of explicit information as "meaning provider". In addition, study 3 demonstrated that the effect of the combination depends on the ability of explicit information to load and transfer a meaning to the meaningless reminder. This effect manifests itself in both enhanced sustainability perception and actual sustainable behaviour. Providing associative information is shown to reduce feelings of scepticism towards the different sensory properties of sustainable packaging. Associative explicit information positively affected sustainable disposal behaviour, although this does not rely on the implicit cue (meaningless/meaningful). This can be due to the fact that the within-subject manipulation was irrelevant to the discarding task, as consumers were instructed to simultaneously dispose of both packages on their way out. The observed non-significant results for disposal behaviour of biscuits suggest that the effect of sustainability packaging interventions does not carry over to other sustainable behaviours.

4.6 General discussion and implications

The current research conceptualised and tested the new concept of meaningful reminder as a strategy to improve sustainability communication. To understand how such meaningful reminder can be created and used, this study investigates how different packaging design elements combine and interact in affecting consumer sustainable responses. Such design elements are defined as either "explicit cues", as on-packaging text or verbal explanation about the packaging technology or "implicit cues", as colours, tactile properties, auditory elements, transparency/opacity level or graphic. Such a distinction between implicit and explicit cues is based on the process through which they convey meaning to consumers; the explicit cues through a deliberate, cognitive and informational belief formation route (Fishbein & Ajzen, 1977; Steenkamp, 1990) and the implicit cues through an associative inferential route (Lindh et al., 2016a; Steenis et al., 2017; Underwood, 2003).

Across three studies and two replications (for study 1), we showed how explicit and implicit packaging design cues can be used to the advantage of sustainability, increasing sustainability salience, perception and sustainable behaviour. The effect of the combination varies depending on whether

implicit cues are inherently meaningful or meaningless and whether explicit cues can load a meaning to the meaningless reminder, when this is missing. Our results show that combining explicit cues to an already meaningful implicit cue can be counterproductive, not leading to any (or substantial) increase or even a decrease in sustainability salience and perception. In other words, more cues lead to lower levels of sustainability ("more is less" or "more is enough"). This result supports prior research suggesting that the demand for external information decreases when information about a product is already present in consumers' mind (Schmidt & Spreng, 1996; Vos, 2017), as in the case of meaningful cues with a priori sustainability association. These findings are also in line with research on green confusion, green scepticism and green washing indicating that an overload of "green" information can lead consumers to question the real environmental efficiency and to perceive the product as less sustainable (Aji & Sutikno, 2015; Magnier & Schoormans, 2015; Mitchell et al., 2005; Vincent-Wayne & Vassilios, 1999).

Combining explicit cues to a meaningless implicit cue can increase sustainability salience, perception and even sustainable disposal behaviour of the packaging. In other words, more cues contribute to sustainability. This depends on the ability of the explicit communication to create an association between the meaningless implicit cue (e.g., a different packaging sound) and the higher level of sustainability. In this case, the combination of design elements creates a meaningful reminder: the explicit information provides a reason (sustainability) to believe and understand the distinctive sensory properties that, thus, become meaningful. Vos (2017) similarly suggested that the effectiveness of sustainability claims depends on the extent to which they explain (or make understandable) packaging sustainability. Claims without such explanation were considered less credible and required a higher level of trust from consumers (Vos, 2017). Similarly, we showed that combining non-associative explicit information makes consumers more sceptical and doubtful about the sustainability of packaging, interpreting such combination as "too much to be true" or harmful for the actual sustainability.

4.6.1 Theoretical implications

Our findings contribute to research in environmental psychology, innovation and product design by addressing the controversial perspectives on the interaction between explicit and implicit communication and its effect on sustainability. To our knowledge, this is the first (publicly available) research to systematically study how explicit and implicit cues combine and interact in affecting a different range of sustainable responses, such as sustainability salience, perception and sustainable behaviour. We demonstrate the conditions under which such combination of cues can increase, leave unaffected or even decrease sustainability, adding clarity to a phenomenon with conflicting perspectives.

Contributing to the research in communication strategies and new product design, this chapter conceptualizes and tests the new concept of meaningful reminder. Such a concept encompasses what an innovation should have to be recognized and understood as intended: a reminder and a meaning provider. Our findings show how such meaningful reminders can be created, as a one-step or two-steps process, depending on whether the "automatic flow of business as usual" is disrupted (through the reminder) and re-stored (by providing a meaning) through a meaningful reminder (one-step) or by combining a meaningless reminder with an explicit cue that transfers the intended meaning (two-steps).

The current work also adds to the understanding of the inferential and informational processes in packaging belief formation, relevant to sustainability communication within and beyond the packaging domain (Koenig-Lewis et al., 2014; Magnier & Schoormans, 2017; Steenis et al., 2017; Vos, 2017). Our focus on the interaction effect contributes to this literature that has mainly studied these processes separately, based on single implicit and explicit cues (Chan & Lau, 2004; Steenis et al., 2017; Van den Heuvel et al., 2007).While previous studies investigated how informational beliefs are formed through on-packaging cues, as logos and labels (Rettie & Brewer, 2000; Van Rompay & Veltkamp, 2014), our research shows similar effects with external information provided by an authoritative third-party, suggesting that explicit communication works regardless of the channel.

Last, our research provides contributions to environmental psychology and eco- design by exploring the linkage between packaging design and sustainable behaviour. Prior studies have often overlooked this phenomenon, predominantly focusing on pre-purchase stages (Lindh et al., 2016a; Magnier & Schoormans, 2017; Steenis et al., 2018; Steg et al., 2013) and missing real life set-ups (Borgman, 2018). The current study demonstrates an effect on sustainable behaviour, both in terms of disposal of the packaging and sorting.

4.6.2 Practical implications

Our findings might be of use for marketeers, packaging designers and policy makers, involved in improving the communication of new sustainable technologies. Our results show to designers and marketers when and under which conditions explicit and implicit cues can improve, leave unaffected or decrease sustainable responses. Overall, this chapter provides scientific based evidence in the field of packaging design, which is often driven by intuition (Spence & Gallace, 2011).

We revealed that the intuitively plausible strategy of adding cues can actually be counterproductive. Designers and marketers might indeed opt to add explicit information on the packaging when implicit cues have no prior association with sustainability, avoiding the so-called "green overload confusion".

As sustainability is becoming an increasingly important criterion in consumer decision making (Banerjee et al., 2003; Peattie & Peattie, 2009) and the technology is going hand in hand with this trend (Boz et al., 2020; Olsen et al., 2014), designers and marketers need new communication strategies to signal both newness and improved environmental efficiency. By testing a variety of different sensory properties, including auditory and tactile elements, our results provide suggestions to packaging designers beyond visual packaging elements (green colour, natural look, images etc..) in the sustainability communication (Creusen & Schoormans, 2005; Magnier & Schoormans, 2015; Pancer et al., 2017; Steenis et al., 2017). Specifically, our results (study 2) showed that the distinctive sensory features of eco-materials can be used by companies as effective reminders for sustainability, rather than hidden in the overall design.

Moreover, rather than adopting generic claims which risk to be interpreted as forms of greenwashing, marketers should consider formulating specific and associative statements that link the distinctive properties of sustainable packaging with the higher sustainability and provide "a reason to believe" (e.g., "*This is a new type of packaging, can you hear/feel its sustainability*?", "*Can you hear the new sound of green/ sustainability*").

By demonstrating that such associative statements, provided through an authoritative external source, can stimulate disposal behaviour, this research provides implications relevant for policy makers or institutions committed to promoting recycling behaviour. For example, municipalities could consider encouraging sustainable disposal behaviour through advertisements in which governmental agencies or experts on the subject provide information on a new packaging technology, linking to its sensory features.

4.7 Limitations and further research

The current studies have some limitations that should be acknowledged. First, this study does not take into account a supermarket context to simulate respondents' real life cognitive load, which influences consumers' responses to visual and verbal cues (Hoegg et al., 2010; Shiv & Fedorikhin, 1999). In all our studies, respondents were specifically instructed to interact with the packaging as much as possible and had time to cognitively elaborate on all the information provided. In the supermarket context of high cognitive load, low resources and motivation, it is likely that consumers would not process the explicit cues with the same level of attention and commitment as in our studies. Our study does, however, show promising effects that go beyond explicit cues alone and shifts attention to implicit cues that are less susceptible to low cognitive resources. Future research could test the influence of implicit and explicit cues in different conditions of cognitive load in order to determine whether in situations of high cognitive load consumers' sustainable responses would be influenced to the same extent by implicit and explicit cues. Similarly, studying individual differences in cognitive abilities might help to understand the level of resources that different consumer groups allocate and need to process sustainability related messages. As the persuasive power of a message is not only influenced by individuals' cognitive abilities but also by their motivation, it could be interesting to study whether people with high

(vs low) sustainability motivations are differently affected by the eco-implicit and explicit cues. Based on the Elaboration Likelihood model of persuasion (Petty & Cacioppo, 1986), we could indeed assume that individuals who care for sustainability are more likely to get persuaded by the quality of an argument, such as a strong explanation on the packaging's environmental efficiency. On the contrary, consumers with low sustainability motivations might be more likely to get affected by peripheral attributes, such as a green colour, the number of arguments provided or the mere presence of an expert (Manca et al., 2020; O'Keefe & Jackson, 1995; Wagner & Petty, 2011).

This research's attempt to create an association between the meaningless implicit cues and the improved sustainability was limited to one confrontation. In reality, the learning process in which consumers create and grow these associations generally occurs over time and relies on repetitive encounters with products. While our findings show that explicit information can "load" sustainability associations to meaningless implicit cues, to confirm whether this happens in the long term, future research could include a longitudinal or time-extended study that investigates this effect across multiple encounters with the stimuli.

Similarly, while our studies suggest that explicit communication provided through on-packaging labels and external sources have similar effects, future work could explore this effect with different types of labels (private vs official) and/or third-party sources (more or less trustworthy and authoritative). This could indicate whether the effect of the explicit communication depends on perceived authority and trustworthiness.

Despite these limitations, the present research showed consistent and robust results on how packaging interventions can be used to improve sustainability communication. This is achieved through different 1) packaging technologies (biodegradable and compostable materials, recycled materials, blow device technology to extend food shelf life), 2) product categories (biscuits, baby food, fresh salad), 3) measures for sustainable consumer responses (lexical decision task, thought listing task, Linkert scales, observation of food waste and packaging disposal behaviour) and 4) specific manipulations for implicit (for study 1: rough tactile property, graphic for the blow device and non-uniform look, for study 2: sound, opacity level, sticky tactile property, graphic, colour, for

study 3: sound, opacity level, sticky tactile property, graphic) and explicit cues (for study 1: logo and explanation of biodegradability, blow device technology and recycled materials, for study 2: logo and explanation of biodegradability and recycled materials, for study 3: verbal information through a packaging expert about recycled materials).

Overall, this research has identified an effective combination of explicit and implicit design elements, coined as the Meaningful Reminder, as a promising step forward towards an improved sustainability communication.

4.8 Acknowledgements

The authors of this research thank the packaging experts and graphic designers from the *Kennisinstituut Duurzaam Verpakken* (KIDV) and *Plato product consultants* for the creation of the mock-ups packaging used in this research and the MYPACK consortium for providing the packaging materials. Specifically, the authors thank Marcel Keuenhof and Karen van de Stadt from KIDV for the design, creation and transportation of the stimulus material. The authors also thank Dominique Vogelzang for her intense and fruitful collaboration in study III, Matika Kormeling and Max Coenen for their help in the coding procedure and Joost Mostert who kindly volunteered for the recording of the video materials.

4.9 Appendices

Appendix F: Stimuli for study 1

Appendix G: Lexical decision task, study 1

Appendix H: Stimuli study 2

Appendix I: Study 3

Appendix F: Stimuli for study 1

Table F.1: Pictures of the biscuits packaging for study 1a (front and back of the packaging, brand and logo).

Control packaging		
Implicit cues		
Explicit cues		

Combination	 
Logo of biodegradable and compostable packaging	 
The brand Granny	

Table F.2: Pictures of the salad packaging for study 1b.

Control packaging	
Implicit cues	
Explicit cues	

Combination	
Logo for the blow device	

Table F.3: Pictures of the baby food packaging for study 1c.

Control packaging	
Implicit cues	
Explicit cues	

Combination	
Logo of recycled material	 

Appendix G: Lexical decision task, study 1

Table G.1: list of words and non-words used in the lexical decision task

Target words	Letters	syllables	Control words	Non-words
Duurzaam	8	2	aandrang bakplaat feestdag	zweskand somspeen nijmpang dauwdoof
Natuur	6	2	razend dammen fanaat	begant sorrig okfoor papper
Milieu	6	2	expres kelder oordop	autakt troven relmen zempen

Table G.2: Details on the coding procedure for study 1a, b, c, study 2 and study 3.

Code	**Meaning and examples of thoughts and feelings mentioned by respondents.**
Sustainability	Anything related with sustainability of the packaging: natural, ecological, good for the environment, ecologically responsible, recycled.
Sustainability negative	When sustainability is mentioned in a negative way: environmentally unfriendly, too much packaging, unsustainable, bad for the environment.
Product quality	Anything related to the quality of the biscuit: fresh, healthy, crispy, tasty, texture, coconut, lemon, delicious.
Bad packaging quality	Anything related to the bad quality of the packaging: hard to open, annoying sound, vulnerable, cheap, too easy to open.

Convenience	Easy to open, good visibility, good quality of the packaging
Hedonic	Aesthetic of the packaging in positive terms: attractive, pleasant, nice, pretty
Hedonic negative	Aesthetic of the packaging in negative terms: unattractive, boring look, unpleasant
Sensory properties	Anything related to the sensory properties of the packaging (neutral judgement): soft, rigid material, hard plastic, sound, transparent, opaque, sticky.
Novelty	Different, new, curious, special, weird, different from plastic
Scepticism	Not trusting/believing that the packaging is sustainable: scary, doubtful, sceptical, unclear, not sure, does not give me a reassuring feeling, I don't believe it is really sustainable, it raises many questions, I can hardly imagine this can be good for the environment.

Appendix H: Stimuli study 2

Table H.1: Pictures (and audios) of the biscuits packaging for study 2.

Implicit cue-absent (without and with explicit cue-biodegradable and compostable/ recycled material)		 
Implicit cue-sound (alone and in combination with the explicit cue)	 Video for audio: https://youtu.be/D08WyJZbpW0	 

Implicit cue-touch (alone and in combination with the explicit cue)	 Video: https://youtu.be/2ry3Hj4O2J4	 
Implicit cue-opacity (alone and in combination with the explicit cue)		 

Implicit cue-natural look (alone and in combination with the explicit cue)		 
Implicit cue-green colour (alone and in combination with the explicit cue)		 

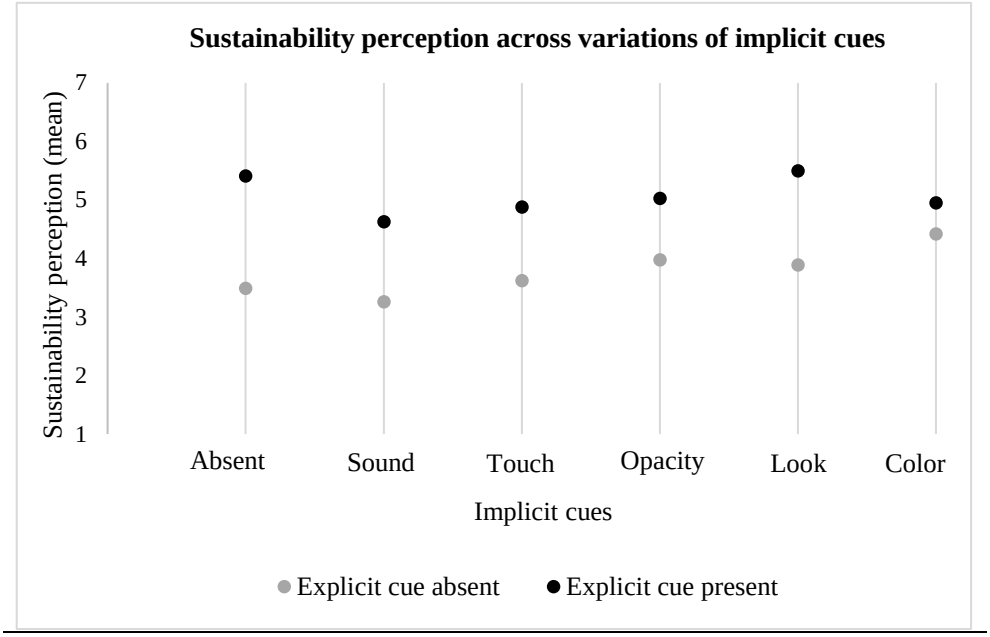


Figure H.1: Sustainability perception across variations of implicit cues with and without explicit cues. The difference between the grey points and the black points on each vertical line indicates the increment in values from explicit cue absent to present.

Appendix I: Study 3

Table I.1: Extra results of the coding procedure

Frequencies of the code mentioned	Meaningless implicit cue (n=57)	Meaningful implicit cue (n=57)	Chi-square/ p-value
Sustainability	22	45	9.82, p =.00
Sustainability negative	26	14	4.08, p =.04
Convenience	66	33	15.48, p =.00
Product quality	77	60	3.36, p =.07
Bad packaging quality	94	97	0.11, p =.74
Sensory properties	113	96	7.28, p =.06
Hedonic positive	61	56	0.36. p =.57
Hedonic negative	14	23	2.46, p =.12
Novelty	23	10	5.67, p =.02
Scepticism	22	9	6.00, p =.01

Figure I.1: Picture of the bin station, study 3.

Figure I.2: Fragment of the video material in study 3.

5

Chapter V
General Discussion

The overall ambition of this thesis was to contribute to the understanding of routine disruption for sustainable behavioural change and was centred around the question of: "*How can we facilitate the disruption of companies and consumers' routines to pave the way towards a more sustainable behavioural change?"*. Three research angles were adopted when answering to this question. A first *innovation management angle* opened this thesis in Chapter 2, by focusing on how to facilitate disruption of companies' routines. Specifically, Chapter 2 has investigated how companies can use consumer insights to step out of their inertia and how new product development (NPD) methods can guide in this process (RQ1). A second *consumer behaviour angle* followed in Chapter 3, which focused on the product-consumer interaction in sustainable product design. In this regard, Chapter 3 analysed how company efforts in product design are decoded and traded-off by consumers, in terms of perceived benefits and sacrifices (RQ2). A third *communication angle* closed this thesis in Chapter 4, focussed on the role of product design in the disruption of consumers' routines. Specifically, Chapter 4 investigated how consumers can utilise business efforts to step out of their inertia and how product design can guide in this process to facilitate sustainable behavioural change (RQ3). Together, these chapters integrate the two perspectives of companies and consumers around the common challenge of routine disruption and extend beyond that with a focus on the interaction between the two.

This chapter summarizes the findings by reflecting on the contribution to the main research question and beyond. Theoretical, methodological and practical contributions of this thesis are addressed, with particular attention to the specific field of packaging innovations as research context. The limitations of this work and avenues for future research are then discussed, followed by a conclusion section.

5.1 Summary and contribution to the main research question

How can we facilitate the disruption of companies and consumers' routines to pave the way towards a more sustainable behavioural change?

Our findings in Chapter 2 provided unique theoretical insights and an innovative practical tool, the MUD method, to guide companies in disrupting their routines and inertia, to the advantage of the new product development (NPD) process. This was achieved by conceptualizing and

validating a novel hybrid method for physical NPD, thus responding to recent calls from innovation management scholars (e.g., Bianchi et al., 2020; Cooper and Sommer, 2016b; Lee and Xia, 2010; Recker et al., 2017). The added value of the MUD lies in the hybrid integration of stage-gate methods with more agile approaches, as a crucial facilitator to proactively detect, keep pace of and strategically respond to external changes (e.g., emerging consumer demands, technological advancements or new environmental problems) thus, overcoming organizational inertia.

The MUD reaches these objectives through a two-step process: *an awareness phase* centred around the identification of misalignments from the status quo and *a strategic management phase*. The findings in Chapter 2 have demonstrated how to guide companies through their awareness phase; in the identification of (mis)alignments at specific level of the NPD process, at goals, benefits or cues level. Such increased awareness and systematic identification of misalignments are gained through an innovative approach that this thesis proposes, namely the implementation of the hierarchical means-end-chain perspective in combination with stage-gate methodologies (in particular with their inherent discipline, rigor and linearity) to both designers and users' perspectives.

Next to increasing companies' awareness of their own NPD activities, the MUD revealed to be a powerful tool to support companies in the strategic management of misalignments, as second, sequential stage in routine disruption. In this regard, Chapter 2 fills a highly relevant theoretical and methodological gap, by showing how agile methods (and their proactive, iterative and reflection-oriented perspective) can allow companies to detach from a conservative, highly routinized and up-front defined approach and open up towards a more progressive and dynamic vision. As a result of the reflective stage of the MUD, companies and designers become more receptive towards misalignments from current market trajectories, that were embraced as learning opportunities for the NPD process.

The conceptualization of the MUD in Chapter 2 brought to surface a theoretical gap, namely the link between routine disruption and sustainable behavioural change. Filling this gap, Chapter 4 conceptualized and validated a theory-based strategy, the Meaningful Reminder, to disrupt consumers' routines and guide towards a more sustainable behavioural change. Chapter 3 lays the foundations for achieving this objective, by investigating factors

and processes underlying consumer sustainable decisions and behaviour. Thus, we have first shown how product design leads to the creation of consumer associations (for sustainability and beyond) (Chapter 3), to then demonstrate how these existing associations can be disrupted (Chapter 4). The findings in chapter 4 provided novel and clear indication of how product design can first disrupt consumer automatic flow of "shopping as usual", through a "reminder", and then re-store the flow, conveying the intended meaning of sustainability and functioning as "meaning provider". As a result of routine disruption, consumers were able to better detect changes in the shopping environment (e.g., a technological advancement in the usual product-packaging offer) and were more receptive to sustainability-related signals. By guiding consumers towards a more sustainable behavioural change, product design was proven successful in strengthening consumers' perception of sustainability and even to foster a more sustainable disposal behaviour of the packaging.

5.2 Theoretical contributions

This thesis makes several theoretical contributions beyond the existing knowledge on innovation management, sustainability and product-packaging design, in particular.

5.2.1 Contributions to the innovation management literature

This thesis departed from the observation that, in light of the present environmental crisis, a sustainability transition is urgently needed to halt further deterioration. Sustainability transition requires a shift away from the status quo (current situation) into a more sustainable direction (Bruijnes et al., 2020; Kardos, 2012; Klaniecki et al., 2016; Mulder, 2007). Essentially, this will have to manifest itself in both companies and consumers' practices, as a shared responsibility between the supply (companies, retailers) and the demand (consumers) (Robert et al., 2005; Johnson, 1994; WCED, 1987). This is far from an easy challenge as production and consumption patterns have been progressively engrained in habits and routines, preventing search for and consideration of alternative (and potentially more sustainable) courses of action (Arrow, 1962; Betsch et al., 2001; Fazio et al., 2000; Seebode et al., 2012; Verplanken & Wood, 2006). Routines and inertia at both sides (companies and consumers), thus, hamper a sustainable behavioural change, which may be facilitated by a process of (routine) disruption, as emphasized

by innovation management research (Anderson Jr & Lewis, 2014; Guha, 2015; Leonard, 1995; Mousavi et al., 2018; Turner & Rindova, 2012; Zellmer-Bruhn, 2003).

While it was evident that disrupting companies' routines and overcoming organizational inertia are at the core of a more sustainable development, it was less clear how this disruption can be facilitated and how the NPD process can guide towards this purpose (Hjorth & Madani, 2014; Kennedy et al., 2017; Seebode et al., 2012). This thesis contributes to the innovation management literature, by providing a critique of the prevailing NPD methods, which run the risk of reinforcing established practices and alignments with the status quo. By acknowledging the importance of more agile and hybrid methods, as potential game-changers to revitalize the NPD process, this thesis adds to the innovation management literature and practice. In particular, this thesis showed that there is an added value of critically and strategically reflecting on the misalignments between companies and consumers' assumptions, not from the perspective of misfit or failures, but as inspirational inputs to the NPD process. Deviations and uncertainties are therefore welcomed rather than merely controlled. The systematic identification and proactive management of misalignments in the early stages of the NPD process brought additional analytical and strategic insights to the companies under investigation, potentially leading to higher level of creativity, dynamism and innovation, and breaking down company resistance to change.

This thesis contributes to the innovation management literature also through a very specific lens, namely the Means end chain theory (MEC) (Olson and Reynolds, 2001; Reynolds and Gutman, 1988), on which all the chapters of this thesis are theoretically grounded and contribute to. The MEC approach and its practical implementation in the interviews' laddering procedure are typically used to investigate users/consumers' perceptions of an innovation, based on a bottom-up process from concrete (product cues) to abstract (in terms of consumer benefits, goals, values) (Olson and Reynolds, 2001; Reynolds and Gutman, 1988; Steenkamp and Van Trijp, 1997). This thesis has broadened the MEC perspective beyond the bottom-up process and has introduced an alternative and innovative way of looking at the cues-benefits-goals links, through a top-down perspective as well. This extension and innovative application of the MEC, realized by integrating the insights

from the Goal determination theory (Ratneshwar et al., 2003), have been instrumental to simultaneously look at company and consumer perspective, as two faces of the same NPD coin, as a top-down incorporation and bottom-up abstraction process, respectively. This insight has advanced company understanding of its daily practices, of why alignments and deviations may emerge between business decisions and consumer demands and, most importantly, of how to strategically use this knowledge to the advantage of the innovation process.

5.2.2 Contributions to the sustainability literature

As a collective responsibility (Robert et al., 2005; Johnson, 1994; WCED, 1987), sustainability transition and behavioural change can only occur at the interaction between the supply and the demand: for companies, in which products they bring to the market, and for consumers in how they adjust their choice patterns to give priority to sustainability. Product design principles and consumer research provide important links in this process, connecting product supply to consumers' needs and vice versa (Cooper, 2019; Grunert and van Trijp, 2014; Morgan et al., 2018; Ulrich, 2003; Urban and Hauser, 1993). In this regard, prior research has largely investigated how product design cues provide benefits to consumers and how these benefits, such as sustainability, are decoded by consumers from the concreate product features (i.e., inference making process) (Gutman, 1982; Grunert, 2010; Olson and Reynolds, 2001; Reynolds and Gutman, 1988; Steenis, 2019).

In the sustainability literature, primary attention has been paid to the sustainability as a benefit per se, thus studying how consumers perceive, interpret and/or evaluate a higher level of sustainability or how consumers respond, accept and/or intent to purchase sustainable alternatives, in relation to the enhanced sustainability benefit (Herbes et al., 2018; Ketelsen et al., 2020; Lindh et al., 2016a; Magnier & Schoormans, 2015; Steenis et al., 2018). This thesis extends this literature, by integrating the sustainability in a broader picture, not as an isolated consumer benefit, but in relation to other relevant decision criteria, which may compete with sustainability. This perspective that interlinks sustainability with other benefits and potential drawbacks, does not only form our theoretical foundation but is also practically implemented within this thesis' study design. An important contribution of the present thesis is that, through a fractional cyclic design, it integrates and analyses the complexity through which (sustainability

related) design cues serve as signals to consumers to infer multiple benefits and sacrifices. The analysis of this complexity allows to understand the interconnected network of relationships between cues-cues links, cues-benefits links and benefits-benefits links. This thesis confirms how the trade-off process is not the result of a one-to-one relation but of many-to-many: a single design cue did not only have a strong effect on perceived sustainability, but substantially influenced other benefit perceptions, in a positive and negative direction simultaneously.

Moreover, this thesis has advanced the understanding of two important phenomena, the first related to the "price of suitability" and the second related to the "power of sustainability", both proving important contributions to the sustainability literature. First, this thesis offers a more realistic and fuller understanding of consumer acceptance of sustainable alternatives, by showing "the price of sustainability", namely how consumers respond to sustainable alternatives when these come at the expense of other relevant benefits (e.g., convenience, preservation, aesthetic quality). Second, this thesis provides innovative insights about the "power of sustainability", namely the ability of an enhanced sustainability perception to absorb potential drawbacks and prevent consumers from perceiving some of the losses. Specifically, our finding in Chapter 3 showed that consumer appreciation of sustainability can be strong enough to filter out (or absorb) some of the drawbacks. When consumers had to sacrifice a single competing benefit for a higher level of sustainability, they tended not to perceive the potential loss, such as an inferior performance in terms of convenience or aesthetic quality. In more extreme cases, sustainability did not only absorb or attenuate the loss but also increased the positive perception of other benefits. Positive impressions triggered by sustainability tended to "spill-over" to other unrelated benefits. Our finding also revealed the threshold beyond which the absorption capacity and the spill-over effect of sustainability failed, and the losses were perceived.

Last, this thesis contributes to the sustainability literature, by providing a new method for the early experimental stages of the NPD process (as concept testing, prototyping, product testing) which could be timely moment to still integrate sustainability into the NPD process. By adopting the MUD method in the early phases of the NPD process, companies may understand how sustainability can be integrated in the NPD process or whether/how a

prototype actually signals sustainability to consumers, as valuable insights for the later NPD phases. Through the MUD, this thesis advances the understanding of what sustainability implies in practice to designers and users (e.g., a bag vs a box, glass vs paper, lid vs no lid etc..), providing relevant implications for theory and practice in the field of eco-design and for the long-standing challenge about market adoption of more sustainable innovations.

5.2.3 Contributions to the product-packaging design literature

By addressing companies and consumers' perspective in the perception process (Chapter 2), decision making (Chapter 3) and behaviour (Chapter 4) towards new product-packaging combinations, this thesis contributes to research on product-packaging design. Specifically, this thesis adds to those studies and models that have attempted to identify factors and contributors for new product adoption and diffusion (e.g., Bass, 1969; Davis, 1989; Mahajan et al., 2000; Rogers, 1976; Venkatesh, 2000). The technology acceptance model (TAM), for example, identified perceived "usefulness" and "ease of use" as meta-benefits influencing consumer decisions and acceptance of new technologies (Davis, 1989). Within the packaging domain, this thesis identified the meta benefits of convenience, preservation & protection and aesthetic quality, with sustainability functioning as an extra meta-benefit which may or may not be compatible with (any of) the other three. An important contribution of the present thesis lies in the analysis of the interrelations between the meta-benefits, not as one-to-one relations but as many-to-many. In addition to that, this thesis contributes to the product-packaging design, by investigating whether the perception and evaluation of these meta-benefits depends on and varies across product, packaging and consumer related factors. In this regard, the results of the path analysis in Chapter 3 showed how the cues-benefits relations varied across some product and consumer differences, such as those related to country or nationality.

Last, enriching the understanding of the persuasion and communication power of product design (Ampuero & Vila, 2006; Creusen & Schoormans, 2005; Hultén, 2011; Pancer et al., 2017; Steenis et al., 2018; Steenis et al., 2017), this thesis showed how (implicit and explicit) packaging design elements and their interaction can effectively communicate to consumers in terms of distinctive positioning and added relevance (for users' needs). Specifically,

this thesis has shown how product and packaging design can represent and be used as Meaningful Reminders, as an effective instrument for behavioural change; to disrupt consumers' routines and open a window of opportunities for new associations, perceptions and behaviours. By systematically studying the interaction effect of implicit and explicit communication on a range of different consumer responses, this thesis contributes to packaging research which has mainly studied implicit and explicit design strategies in isolation (and not combined) (Ampuero & Vila, 2006; Creusen & Schoormans, 2005; Hultén, 2011; Pancer et al., 2017; Steenis et al., 2017, 2018). In addition, this thesis contributes to provide clarity to a phenomenon with conflicting perspective, namely the effect on "over-featuring" in product design (e.g., Marzi, 2022). In this regard, the findings of Chapter 4 shown the conditions under which the combination of implicit and implicit design elements can represent a case of over-featuring, with implications for sustainability communication.

5.3 Methodological reflection

This thesis also makes a methodological contribution to the field of sustainable behavioural change. Across the three empirical chapters, this thesis applied a method triangulation, namely the use of multiple and different methods such as qualitative interviews (in Chapter 2), quantitative surveys (in Chapter 3) and experimental studies (in Chapter 4) to understand routine disruption for behavioural change (Thurmond, 2001).

The multi-method research design of this thesis provided additional insights that could not have been gained from any of the methods alone. In particular, the initial qualitative exploration of the research problem, through face-to face interviews and focus group interviews, provided a very in-depth understanding of how designers and users' perceptions are formed. This rich and comprehensive insight was highly informative to the design of the following chapter, which deepened the research topic through a large quantitative survey and a representative approach (with five different European countries). As a result of this multi-method perspective, this thesis contributed to a fuller understanding of consumer routine disruption for sustainable behaviour change, first exploring consumer perceptions and then zooming in on decision-making, trade-off and variations across consumer groups (through a quantitate cyclic design). By adding beyond explicit measures, which captured self-reported and expressed responces (as

in interviews or surveys), this thesis integrated implicit measures as well (e.g., lexical decision task and real-life observations of consumer disposal behaviour), often advocated by marketing and psychology researchers for their advantage to capture automatic and unconscious processes (Ariely, 2008; Gawronski et al., 2006; Holland et al., 2005; Nevid, 2010; Znanewitz et al., 2018). Thus, by also relying on more indirect and implicit methods, less biased by social desirability (i.e., the tendency to give socially acceptable responses to direct questions), this thesis alleviates the intention-behaviour gap, central in sustainability literature (Lindh et al., 2016; Magnier & Schoormans, 2017; Steenis et al., 2018; Steg et al., 2013). In addition, by combining 3D virtual designs but also physical prototypes, pre-purchase (perceptions, evaluations, intentions) and post-purchase stages (disposal behaviour), the multi-method approach of this thesis benefitted the external validity of the findings and contributed to a more real life set-up, often lacking in consumer research (Borgman, 2018). *Table 5.1* summarises the methods used in this thesis and the respective research purpose.

Table 5.1: Methods used in this thesis

Method	**Measure/purpose**	
Face to face interviews with users and designers across different countries with laddering technique (qualitative)	Retrieve bottom-up abstraction process and top-down incorporation process underlying users and designers' perceptions of the same innovation.	Chapter 2
Comparison between hierarchical value maps (users' links) and goal implementation maps (designers' links)	Identification of misalignments between designers and users at goals, benefits and cues level, as first (awareness) phase in disruption of companies' inertia.	Chapter 2
Focus group interviews with designers (qualitative)	Strategic management of misalignments at the advantage of the innovation process, as second phase in in disruption of companies' inertia.	Chapter 2

Survey with 5035 consumers across five EU countries (quantitative)	Collect data on benefit perceptions, purchase intention for sustainable product-packaging alternatives and consumer characteristics.	Chapter 3
Fractional cyclic design	Simulate consumer trade-off between benefits and sacrifices.	Chapter 3
Path analysis and multi-group path analysis	Identify cues-benefits relations and validate these relations across product/packaging and consumer differences.	Chapter 3
Lexical decision task (implicit method) and Thought listing task (explicit method)	Measure the activation of sustainability construct in consumers' mind when confronted with packaging prototypes (salience of sustainability)	Chapter 4
Self-reported sustainability perception	Measure sustainability perception of packaging	Chapter 4
Experimental setting with garbage bins and doggy bags	Measure consumer disposal behaviour of the packaging and its content	Chapter 4

5.4 Practical contributions

The research on the MUD method, The Meaningful Reminder and the knowledge developed on consumer trade-off have a wide spectrum of uses for marketers, designers and policy makers. The MUD method can be used by companies to gain specific insights on which levels of the NPD process their designers and users start to disagree and their perceptions to misalign. This analytical understanding of how, where and why designers and users are misaligned helps companies to implement strategies tailored to their practices and vision. Moreover, the insights obtained on benefit perceptions and purchase intentions for sustainable packaging alternatives have important practical implications in the field of packaging design.

Specifically, the findings on the extent to which today's European consumers are willing to compromise benefits such as convenience, preservation or aesthetic quality for a higher sustainability, offer designers a set of specifications for a (potentially) more successful product development process. Understanding which cues signal sustainability most and how this differs across consumer characteristics, such as age, gender, lifestyle or values, can lead to a more specific, sharp and tailored (packaging) development and communication.

The scientific-based evidence provided by the study of The Meaningful Reminder contributes to the field of design, within and beyond packaging, which is often driven by intuition. Our results suggest designers and marketers involved in communicating the added value of their innovations in various ways. Among others, our research has showed 1) which sensory cues function best as effective reminders for sustainability, as opposed to remaining hidden in the overall design, 2) how to link distinctiveness with meaning through an explicit and implicit communication and 3) when and under which conditions a combination of communication strategies can improve, leave unaffected or decrease (sustainable) consumer responses. Last, by demonstrating how explicit communication can stimulate sustainable disposal behaviour, this research is of use for policy makers committed to encouraging recycling practices or, more generally, societal changes in a more sustainable direction.

5.5 Limitations and future research

Across our studies we have developed theoretical insights and practical interventions to facilitate the disruption of companies and consumers' routines for a more sustainable behavioural change. Although the MUD method, the study of consumer trade-off and The Meaningful Reminder serve this purpose, these represent only some of the "paths" that can be followed. Different and future research directions can be envisaged. In the next section, research avenues are addressed that go 1) beyond the hybrid aspect of NPD methods to facilitate companies' behavioural change, 2) beyond product design to facilitate consumers' behavioural change, and 3) beyond the packaging context, thus overcoming some of the limitations of the current thesis.

5.5.1 Beyond hybrid methods

This thesis has conceptualized and validated a hybrid method (the MUD), partly stage-gate and partly agile, to guide companies beyond their established routines and resistance to change. Such a hybrid aspect, applied in the context of physical product innovation, has proven useful to disrupt companies from their "business as usual", mainly centred around alignments with the status quo. While the MUD method facilitated disruption of company routines by providing analytical (increased awareness of NPD practices) and strategic insights (as a reflection and learning tool), the exploration of whether this disruption leads to a more sustainable behavioural change in companies remained beyond the scope of this thesis. Future research may focus less on the hybrid aspect and on how this can be applied in the context of physical innovation, and more on the effects of disrupting companies' routines. Further studies could be conducted to investigate whether routine disruption actually leads to an increased incorporation of sustainability in NPD processes and business practices.

Even more interesting would be to understand *how* the disruption process can lead to a more sustainable development, which represents a very topical issue. Prior research in this regard has often remarked how gradual changes and problem-solving strategies, only aimed at containing (rather than preventing) problems with existing (rather than new) solutions, may not be enough to achieve a sustainable development (Bruijnes et al., 2020; Hellström, 2007; Huesemann, 2003). Radical changes, targeted at a true disruption (radical by definition) rather than at the repair of existing routines, are seen as vital to pave the way towards a sustainable future (Bruijnes et al., 2020; Hellström, 2007; Huesemann, 2003). Although the MUD method was not specifically conceptualized for sustainable NPD, but in general for any physical product development, its relevance and application in the sustainability-related context can be envisaged. Specifically, the agile and proactive approach of the MUD, central in its reflective stage, could be particularly useful in the field of sustainability, where a dynamic and future-oriented vision is requested as never before (Bruijnes et al., 2020; Kardos, 2012; Klaniecki et al., 2016; Mulder, 2007).

5.5.2 Beyond product design

To understand how consumer routines can be disrupted for more sustainable behavioural change, this thesis has mainly focused on the role of product-packaging design (e.g., how explicit and implicit design cues interact in affecting consumer sustainable responses, on The Meaningful Reminder as a design strategy etc..). However, other factors, outside product design, might guide consumers beyond their inertia and towards a more sustainable behaviour. For example, future research could investigate the effectiveness of information campaigns or specific contextual factors, such as household or shopping contexts, and understand how combining these interventions could increase, decrease or leave unaffected a range of different sustainable behaviours. This thesis offered preliminary insights in this regard, demonstrating that on-product information and information provided by an external source (i.e., video information provided by a packaging expert) have similar effects on sustainable responces (Chapter 4).

Furthermore, within the context of product design, this thesis has investigated how to encourage sustainable behaviour (e.g., how to activate the sustainability concept or lead people into a positive sustainability mindset). The Meaningful Reminder represents a theory-based design strategy for this purpose. Further studies could examine weather this same strategy is also useful for discouraging unsustainable choices or behaviours and could address questions such as: "Can The Meaningful Reminder signal to consumers that the product is too cheap to be produced in compliance with fair labour standards or with respect for local communities?" or "How can designers use explicit information or implicit sensory cues that, as soon as they are touched, seen, smelled or heard, make consumers recognize the "unsustainability"? These questions address relevant research issues in a context, such as that of fast-moving consumer goods (e.g., fast fashion), often affected by unsustainable practices at an environmental, social or economic level.

5.5.3 Beyond the packaging context

In the study of company routines, consumer routines and in the interaction between companies and consumers, this thesis has used the packaging (and the MYPACK project) as research context. While representing an interesting case of application for drawing "general rules", food-packaging innovations

remain one of the possible contexts to inform existing knowledge on routine disruption for sustainable behavioural change. For example, broader applications can be envisaged for the MUD method, as for the Meaningful Reminder, in other contexts beyond packaging and even beyond the industry of fast-moving consumer goods, by including, for example, car industry, robotics or services or software. Although practical relevance may differ and some adjustments may be necessary, the theoretical insights developed in this thesis remain general and applicable to different contexts.

5.6 Conclusion

This thesis has contributed to the understanding of how companies and consumers' routines can be disrupted to pave the way towards a more sustainable behavioural change. Three main theoretical insights and their respective practical tools were identified as effective in the study of routine disruption: the MUD method, as an hybrid approach for physical product innovation, that was proven useful to guide companies in their routine disruption (Chapter 2), the study of consumer decision-making process involving sustainability from a trade-off perspective (Chapter 3) and The Meaningful Reminder, as a new design strategy to guide consumers beyond their routines and towards a more sustainable behavioural change (Chapter 4).

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Summaries

English

Italian

English summary

This thesis departed from the observation that, in light of the present environmental crisis, a sustainability transition is urgently needed to halt further deterioration. Sustainability transition requires a shift away from the status quo (current situation) into a more sustainable direction. Essentially, this will have to manifest itself in both companies and consumers' practices, as a shared responsibility between the supply (companies, retailers) and the demand (consumers). Changing company and consumer practices towards a more sustainable direction is far from an easy challenge as production and consumption patterns have been progressively engrained in habits and routines.

Although habits and routines allow companies and consumers to make decisions in a limited amount of time, demanding little attention and cognitive resources, they also prevent search for and consideration of alternative courses of action. As a result of routinized behaviours, companies and consumers find themsleves unable to "think outside the box", anchored to a tunnel vision, to their "business as usual" and their inertia (i.e., the inability to enact an internal behavioural change in face of an external change).

Routines and inertia at both sides (companies and consumers), thus, hamper a sustainable behavioural change, which may be facilitated by a process of (routine) disruption. While it is evident that disrupting routines and overcoming inertia are at the core of a more sustainable development, it is less clear how this disruption can be facilitated and how the innovation process can guide towards this purpose. This thesis contributes to this knowledge gap and centres around the question: "*How can we facilitate the disruption of companies and consumers' routines to pave the way towards a more sustainable behavioural change".* To validate theoretical insights and practical tools on routine disruption, the research presented in this thesis is conducted within an existing European consortium of food packaging innovators, as research context.

Three research angles are adopted when answering to the above research question: an innovation management angle (Chapter 2), a consumer behaviour angle (Chapter 3) and a communication angle (Chapter 4). First focusing on the companies' perspective, this thesis begins with

understanding how *companies* can be guided through the process of routine disruption. By proving theoretical and practical contributions to the field of innovation management, Chapter 2 conceptualizes and validates a new method, named as *MUD-Misalignments Users-Designers*, that helps companies to detach from a conservative, highly routinized and up-front defined approach and give value to misalignments from the status quo. The added value of the MUD lies in the hybrid integration of stage-gate methods with more agile approaches, as a crucial facilitator to proactively detect, keep pace of and strategically respond to external changes (e.g., emerging consumer demands, technological advancements or new environmental problems) thus, overcoming organizational inertia.

After having delved into company perspective on routine disruption, this thesis extended the research focus on consumer decision making, and specifically, on how consumers trade-off conventional benefits against sustainability. In this regard, Chapter 3 opens with the consideration that sustainability transition often asks for sacrifices, both to producers and users. While the analysis of this compromise and trade-off between benefits and drawbacks derived from a more sustainable production is central in the design process, it is rather overlooked in consumer research. Chapter 3 addresses this knowledge gap by integrating a benefits-costs trade-off perspective to the study of consumer acceptance of sustainable (packaging) innovations. Moreover, this chapter investigates how different consumer groups, in terms of age, gender, nationality, lifestyle and values differently cope with sustainable product-packaging decisions. By investigating factors and processes underlying consumer sustainable decisions and behaviour, Chapter 3 lays the foundations for Chapter 4, which proposes a design strategy, named as *The Meaningful Reminder*, to guide consumers beyond their routines, towards a more sustainable behavioural change. Chapter 4 addresses the communication problem of sustainable innovations, which, despite technological investments, are often not recognized by consumers in terms of distinctive positioning and improved sustainability. Through a series of lab studies with physical prototypes, Chapter 4 shows how The Meaningful Reminder can disrupt consumers' routines, facilitate recognition and perception of sustainability and encourage sustainable consumer behaviour.

Together, these chapters integrate the two perspectives of companies and consumers around the common challenge of routine disruption and extend beyond that with a focus on the interaction between the two. All in all, 1) The MUD method, as a hybrid approach for physical product innovation, 2) the study of consumer decision-making process involving sustainability from a trade-off perspective and 3) The Meaningful Reminder, as a behavioural intervention, make important contributions beyond the existing knowledge on innovation management, sustainability and product-packaging design. In addition, they represent validated practical tools that were proven effective in the study of routine disruption, to open a window of new opportunities and alternative courses of action for sustainable behavioural change.

Riassunto (Italian summary)

Alla luce dell'attuale crisi ambientale, una transizione sostenibile (sustainability transition) e' necessaria quanto urgente per fermare un ulteriore deterioramento. Questa transizione verso uno sviluppo piu' sostenibile implica, letteralmente, uno spostamento dallo status quo (la situazione attuale) verso una direzione piu' sostenibile. In sostanza, tale spostamento o trasizione si deve manifestare su due fronti: nelle pratiche aziendali da un lato, e nei comportamenti dei consumatori dall'altro, in quanto responsabilita' condivisa tra l'offerta (le aziende, i rivenditori) e la domanda (i consumatori). Dal momento che i modelli di produzione e consumo si sono progressivamente radicati in abitudini e routine, cambiare queste pratiche (aziendali e di consumo) e' tutt'altro che facile.

Abitudini e routine facilitano i processi di produzione e consumo, rendondoli piu'agili e consentendo ad aziende e conumatori di prendere decisioni in un lasso di tempo breve e con limitate risorse cognitive. Nonostante tali vantaggi, abitudini e routine impediscono sia alle aziende che ai consumatori di considerare linee d'azione alternative. A seguito di comportamenti fortemente abituali, aziende e consumatori si trovano cosi' incapaci di pensare al di fuori degli schemi, ancorati a una visione ristretta, ad una tunnel vision, a loro business as usual, e alla loro "inerzia" (ovvero l'incapacita' di attuare un cambiamento comportamentale interno di fronte ad un cambiamento esterno).

Le routine e la cosiddetta inerzia, sia da parte delle aziende che dei consumatori, ostacolano quindi un cambiamento comportamentale piu' sostenibile, che puo' invece essere faciliato da un processo di interruzione (di queste routine, in gergo "ruotine disruption"). Mentre e' evidente dalla letteratura esistente che questo processo di interruzione e superamento dell'inerzia e' alla base di uno sviluppo sostenibile, non e' altrettanto chiaro come questo processo possa essere facilitato e come l'innovazione possa guidare verso questo scopo. La presente tesi contribuisce a questo gap nella ricerca e risponde alla seguente domanda: "Come possiamo facilitare il processo di interruzione delle routine, sia delle aziende che dei consumatori, per aprire la strada ad un cambiamento comportamentale piu' sostenibile?". Per convalidare le intuizioni teoriche e gli strumenti pratici su tale argomento, la ricerca presentata in questa tesi e' stata condotta in

collaborazione con un consorzio europeo sul packaging e la sua innovazione. Tale consorzio e progetto rappresentano il contesto di ricerca di questa tesi.

Per rispondere alla domanda sopra presentata, questa tesi adotta tre diverse angolazioni o lenti investigative: la prima lente riguarda la gestione dell'innovazione (capitolo 2), la seconda riguarda il comportamento dei consumatori (capitolo 3) e la terza la comunicazione (capitolo 4). Concentrandosi dapprima sulla prospettiva delle aziende, questa tesi parte dalla comprensione di come le aziende possono essere guidate attraverso il processo di interruzione delle routine (routine disruption). Fornendo contributi teorici e pratici nel campo della gestione dell'innovazione, il capitolo 2 concettualizza e convalida un nuovo metodo, denominato MUD-Misalignments Users-Designers, per aiutare le aziende a distaccarsi da un approccio conservatore, routinizzato e orientato ad un costante allineamento con il business as usual. Al contrario, questo nuovo metodo supporta le aziende verso un approccio piu' innovativo che valorizza i misalineamenti dallo status quo. Il valore aggiunto del MUD risiede nell'integrazione ibrida dei metodi stage-gate con metodi piu'agili e si pone come facilitatore cruciale per rilevare in modo proattivo e strategico i cambiamenti esterni (per esempio, nuove domande di mercato, progressi tecnologici o nuovi problemi ambientali), superando cosi' l'inerzia organizzativa.

Dopo aver approfondito la prospettiva aziendale sul processo di interruzione delle routine, questa tesi ha esteso il focus di ricerca al processo decisionale dei consumatori e in particolare, su come i consumatori bilanciano sostenibilita' e altri criteri di scelta (piu' convenzionali). A questo proposito, il capitolo 3 apre con la considerazione che la transizione verso la sostenibilita' richiede spesso dei sacrifici, sia ai produttori che ai consumatori e utenti. Sebbene l'analisi di questo bilancio vantaggi-svantaggi derivanti da una produzione piu' sostenibile sia centrale nel processo di progettazione, e' invece piuttosto trascurata nella ricerca comportamentale e di marketing. Il capitolo 3 affronta questo gap teorico integrando una prospettiva costi-benefici allo studio di come i consumatori valutano e accettano innovazioni sostenibili. Inoltre, questo capitolo indaga su come diversi gruppi di consumatori, in termini di eta', genere, nazionalita', stile di vita e valori, prendono decisioni e scelgono in modo diverso. Studiando i fattori e i processi alla base di queste decisioni e comportamenti, il capitolo 3 pone le basi per il capitolo 4, il quale propone una strategia di progettazione,

denominata il Reminder Significativo (The Meaningful Reminder). Questa strategia ha lo scopo di guidare i consumatori oltre le loro routine, verso un cambiamento comportamentale piu' sostenibile. Il capitolo 4 affronta cosi' il problema della comunicazione, di come comunicare le innovazioni sostenibili, che nonostante gli investimenti tecnologici, spesso non sono riconosciute ne' come differenti (in termini di posizionamento) ne' come piu' sostenibili risetto alle tecnologie convenzionali gia' esistenti. Attraverso una serie di studi di laboratorio con prototipi di packaging, il capitolo 4 mostra come la strategia del Reminder Significativo puo' interrompere le routine dei consumatori e facilitare il riconoscimento e la percezione della sostenibilita', incoraggiando cosi' un comportamento piu'sostenibile.

Insieme, questi capitoli integrano le due prospettive delle aziende e dei consumatori intorno al tema e sfida comune dell'interruzione delle routine. Per concludere, 1) il metodo MUD, come approccio ibrido per l'innovazione fisica, 2) lo studio del processo decisionale dei consumatori che coinvolge la sostenibilita' in una prospettiva di costi-benefici e 3) il Reminder Significativo, come intervento comportamentale, contribuiscono in modo importante al di la' delle consoscenze attuali e rappresentano strumenti pratici efficaci nello studio dell'interruzione delle routine; per aprire una finestra di nuove opportunita' e linee d'azione alternative verso un cambiamento comportamentale sostenibile.

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Joost, my life-mate, thank you for everything. For enriching my life every day, for all the happiness, the imagination, the love. For growing next to me and with me. For all the immense, immeasurable and powerful support from the start to the end of every action, experience, event. You always told me "Giulia, you can make it, everything will be fine". I believed you and this is the result.

The last thanks go to **myself and my changes**, to whom this thesis is dedicated. To me, to my determination, my enthusiasm and to my luck.

Giulia

About the author

Giulia Granato was born in Milan, Italy, on the 14th of June 1992. She graduated in Economics at University of Milan and in Food quality Management (specialisation in management) at Wageningen University. After a period as Research Assistant at the group of Food Quality Design, in 2018 Giulia started her PhD in the Marketing and Consumer Behaviour Group, at Wageningen University.

Giulia's research focused on how to disrupt companies and consumers' routines to facilitate sustainable behavioural change and on consumer adoption of sustainable technologies. During her PhD, Giulia collaborated with food and packaging companies and research institutes across Europe, partners of the European consortium MYPACK on sustainable packaging innovations and food waste. For her research, Giulia uses qualitative methodologies (interviews with laddering techniques, focus group interviews), quantitative methods (cross-cultural surveys) and experimental designs (lab and field experiments with implicit and explicit measures). Giulia's research has been peer-reviewed and published in high-ranking multi-disciplinary journals, in the domain of innovation management, environmental psychology, consumer behaviour and in the field of food and sustainability. Giulia was also extensively involved in the supervision of thesis students and in teaching, in the *Sensory Perception and Consumer Preferences* course.

Giulia got married in August 2021 to Joost, whom she met in a student house during her master. Together, they will travel across South-East Asia after Giulia's PhD defence. In her future career, Giulia see herself in an environment with opportunities to generate new ideas in academic, scientific or business communities. She would like to grow and take responsibilities in an ambitious and international team, with room for joy and friendship and in pursuit of knowledge, creativity and understanding.

List of publications and conference presentations

Scientific publications

Granato, G., Fischer, A. R. H., & van Trijp, H. C. M. (2022). Misalignments between users and designers as source of inspiration: A novel hybrid method for physical new product development. *Technovation*, *111*, 102391.

Granato, G., Fischer, A. R. H., & van Trijp, H. C. M. (2022). The price of sustainability: how consumers trade-off conventional packaging benefits against sustainability. *Journal of Cleaner Production*, 132739.

Granato, G., Fischer, A. R. H., & van Trijp, H. C. M. (2022). A meaningful reminder on sustainability: When explicit and implicit packaging cues meet. *Journal of Environmental Psychology*, *79*, 101724.

Horvat, A., **Granato, G**., Fogliano, V., & Luning, P. A. (2019). Understanding consumer data use in new product development and the product life cycle in European food firms–An empirical study. *Food Quality and Preference*, *76*, 20-32.

Conference presentations

- Presentation within the MYPACK consortium:

Paris, 2017
Stuttgart, 2018
Thessaloniki, 2018
Matera, 2019
Venice, 2019
Online series 2020-2022

- Pangborn conference, *Vancouver 2021* (online format) (presentation of chapter 4 of this thesis)

- EMAC doctoral colloquium, *Budapest 2022* (presentation of chapter 4 of this thesis)

- International product development management conference, *Hamburg 2022* (presentation of chapter 2 of this thesis)

- Eurosense, *Turku 2022* (presentation of chapter 4 of this thesis)

Training and Supervision Plan

Giulia Granato
Wageningen School of Social Sciences (WASS)
Completed Training and Supervision Plan

Wageningen School of Social Sciences

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
A1 Managing a research project			
'Misalignments users-designers as source of inspiration'	International product development management conference, Hamburg, Germany	2022	1
'How multisensory design contributes to sustainability'	MOA Expertise Centre, The Netherlands	2022	1
'The meaningful Reminder on sustainability: when implicit and explicit packaging cues meet'	EMAC doctoral colloquium, Budapest, Hungary	2022	1
'When more is less: the ironic effect of combining explicit and implicit design cues on consumers' perception and disposal behaviour of sustainable packaging'	Pangborn Sensory science symposium, Vancouver, Canada (online version)	2021	1
Consortium meetings MYPACK project (with oral presentation)	European Commission (Paris, Stuttgart, Thessaloniki, Matera, Venice, online series)	2018 - 2021	2
MCB PhD colloquia series	WUR	2018 - 2022	1.5
Research Internship (WASS Scholarship)	ETH, Switzerland	2021	6
WASS Introduction Course	WASS	2018	1
Scientific writing	WGS	2018	1.8
A2 Integrating research in the corresponding discipline			
Quantitative data Analysis: Multivariate techniques, YRM 50806	WUR	2018	2
Experimental research	VU, Amsterdam	2020	6

Academic publication and presentation in social science	WASS	2020	4
B) General research related competences			
B1 Placing research in a broader scientific context			
EDEN doctoral seminar on Consumer Research	EIASM, Bruxelles, Belgium	2018	4
Basic statistics	PE&RC	2018	1.5
Markets and sustainability symposium behavioural Economics and Environmental Decision Making	Groningen University	2020	0.5
B2 Placing research in a societal context			
Presenting with impact	Wageningen in'to Languages	2018	1

C) Career related competences/personal development			
C1 Employing transferable skills in different domains/careers			
Teaching assistant at the course 'Sensory perception and consumer preferences'	MCB	2018 - 2022	3
Master thesis supervision	MCB	2018-2021	1
Effective and efficient communication in academia and beyond	WGS	2022	0.8
Career perspectives	WGS	2022	1.6
Critical thinking and argumentation	WGS	2022	0.3
Brain based teaching	WUR	2018	0.7
Start to teach	WUR	2019	1
Supervising students	WUR	2019	0.6
Total			44.3

*One credit according to ECTS is on average equivalent to 28 hours of study load

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