

Review

Consumer Considerations for the Implementation of Sustainable Packaging: A Review

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Abstract: Packaging sustainability concepts have co-evolved with the increasing incorporation of the principles of sustainable development at various levels within industrial and organizational platforms. Currently, pollution from plastics, packaging-related waste, declining air, soil, and water quality, climate change, and other contemporary challenges are influencing the packaging industry. Barriers such as value chain complexities and negative consumer attitudes due to the economic, social, and environmental demands of sustainable behaviors can discourage companies from the implementation of more sustainable packaging. Hence, packages with improved sustainability may never make their way into the marketplace. However, the next generation of sustainable solutions can be motivated by efforts that fuel a positive consumer attitude towards sustainable packaging. In order to direct efforts, a clear understanding of consumer dynamics in ecological material preferences, willingness to pay, recycling, and factors impacting sustainable behaviors are essential. The objective of this work is to (i) explore the definitions, the impact of sustainable packaging in the value chain, and consumer behavior theories; (ii) review current practices, factors affecting sustainable behaviors, and consumer testing methods; (iii) present three distinct case studies on consumer preferences and value perceptions on bio-based cellulose materials and the impact of on-label claims and pre-evaluation education in consumer preferences; and (iv) to reveal the research gaps and opportunities for consumer research and suggest strategies for stakeholders to communicate packaging sustainability to consumers.

Keywords: sustainable packaging; consumer research; attitudes; behavior; sustainable development

1. Introduction

Sustainability has become one of the integral functions of packaging, in addition to ensuring food quality and safety, facilitating transportation and logistics, and enabling communication. Despite the recent efforts in packaging sustainability, there are opportunities for improvement. Similar to other industries, the packaging industry is now at the nexus of environmental protection, social justice, and economic growth issues, which characterizes the early 21st century business and social frameworks. Sustainability in the packaging value chain can be improved by facilitating collection and sorting for recycling, composting, reuse, and waste-to-energy processing, and other proper disposal and then processing of sorted packaging as well as more sustainable material sourcing and reducing material and resource use, while preserving essential functions of packaging. This challenge is particularly evident with polymer-based food packaging resulting in visible, environmental pollution in waterways and eventually oceans when ill-disposed of as litter [1]. As the constraints of water, land, energy,

and food increase and the declined air quality and overpopulation have grown more acute, the packaging industry is now at a crossroads of employing more sustainable packaging or focusing efforts on motivating consumers to appreciate food packaging more. This conscious choice can have a far-reaching impact, and the latter option can lead to increased regulations, bans, and forced value chain and resource constraints. While the familiarity of consumers with sustainable packaging is increasing, the lack of appreciation for the food packaging function in reducing food waste is spurred on by scenes of ocean plastics and environmental pollution. It is important to note that the term “sustainable packaging” is used throughout this paper, although it is clear that packaging will always have an environmental impact and we are faced with “more” and “less” sustainable packaging versus truly sustainable packaging with no environmental impact. This resulted in a lack of consumer trust and confusion in sustainability efforts for packaging [2–4].

Companies and policymakers have responded to an increased demand from consumers for sustainability initiatives based on the realization of a needed shared value. Packaging sustainability targets of various companies were summarized in a goals database published by the Sustainable Packaging Coalition (SPC) [5]. For example, various corporations including McDonald’s, Unilever, Nestlé, Kraft-Heinz, PepsiCo, and Coca-Cola set targets in action plans for improving the sustainability of their packaging by 2025 and beyond, which includes increased recycling and recycled material while reducing virgin material composition, sustainable sourcing, weight reduction, packaging design for improved recovery, etc. Such commitments, including design and selection of packaging components and materials and value chain modifications, require a substantial investment of resources and sometimes capital with the expectation of increased market and consumer satisfaction. De Koeijer et al. [6] assessed the tradeoffs between sustainability considerations for marketing and packaging development teams at companies, material suppliers, and consultants. Results suggested that the primary challenges for decisionmakers were cost, time-to-market, technical difficulties, and cross-team alignments. As a result, many sustainable packaging solutions without favorable economics and time parameters are not implemented [7]. Unless implementing sustainable packaging is proven to drive sales or reduce costs, companies lack the business case to pursue more sustainable packaging, despite the promotion of their sustainability intentions. This creates a disconnect between what companies say and do as well as what can be done and is actually viable. For example, the statements as such in Coca-Cola’s green leaf logo began to appear [8] and sustainable packaging awards for promising solutions have been presented by several packaging and non-packaging organizations. Such awards may spark ideas, but they can also create consumer confusion by overpromising or simplifying the complexities of implementation. Thus, only a few manifestations of these awards are commercialized.

Such efforts represent the need for making the business cases for sustainable packaging, which involves first assessing the primary function of food packaging—that of protecting food. Once options for food protection are defined, sustainable packaging options can be assessed more viably. This is in strong contrast to focusing on the use of a packaging material and then adding elements to protect the food. This latter approach often results in higher costs and/or a less protected product, resulting in food waste. As stated in the ReFED roadmap report, more sustainable packaging decreases food waste since food waste often has more environmental impact than packaging waste [9]. In the absence of clear communication, consumer dissatisfaction with food packaging is increasing. If essential functions and the role of packaging in the food value chain are not communicated effectively by packaging organizations and companies, consumers develop an incomplete understanding of the role of both packaging and sustainable packaging on the part of consumers leading to product preferences that they believe are sustainable but, in reality, are not [10]. Other factors contributing to the lack of success of more sustainable packaging solutions in the market are associated with poor consumer acceptance of unknown technologies, costs, regulatory issues, lack of viable food product protection (such as moisture barriers), inability to manufacture the packaging material (due to sourcing constraints or material properties), and competitive disadvantages [11]. A better understanding of the current consumer drivers associated with environmentally conscious purchase decisions would aid stakeholders in

developing strategies to encourage sustainable consumer behaviors and make the business case to employ more sustainable packaging.

In light of the presented complexities such as food packaging alternatives, increased packaging regulations, and a better understanding that a business case is needed for a shared value with consumers, detailed assessments and research on consumer dynamics associated with sustainable packaging are needed. This review and exploration has been inspired by the need for a review of research-based solutions for food and packaging industry stakeholders at the center of consumer research and sustainable packaging decision making. Therefore, the objective of the present work is to summarize previous consumer research associated with more sustainable packaging and highlight literature gaps, opportunities, and future research needs. Due to the proprietary nature of novel packaging and products, many consumer testing results are not shared publicly. Thus, in this review, three case studies associated with consumer value perceptions on a bio-based cellulose material, the impacts of on-label claims, and pre-evaluation education in differences of consumer preferences are presented. Web of Science, Google Scholar, and ProQuest databases were scanned using keywords such as “sustainability”, “consumer + research, behavior, attitudes”, “sustainable packaging” and combinations thereof. Further research recommendations presented in this review were created based on research gaps identified and stated explicitly in peer-reviewed research articles, reviews, books, and reports from legislative bodies, multistakeholder and trade organizations, as well as the authors’ experience in food and packaging industries and consumer research and testing. Consumer-related perceptions of sustainable packaging versus the actual life cycle assessment (LCA) of sustainable purchase and post-purchase behaviors are compared. Various consumer responses and attitudes changing with norms, demographics, packaging design elements and cues, and cultural and geographical differences are reviewed. The strategies to improve the consumer acceptance of sustainable packaging when there are known tradeoffs are shared. Additionally, at the end of this work, a table summarizing recent consumer research on sustainable packaging is provided. Thus, this work provides a summary of current issues, references, and future work for the stakeholders including researchers, companies, policymakers, consumers, etc. across the industry.

2. Packaging Sustainability

In this section the meaning of packaging sustainability is discussed from the perspectives of formal definitions, packaging value chain, environmental impact, and food value chain. In many cases, sustainable packaging is assumed to be equivalent to sustainably sourced materials or with enabled recovery such as recyclable or compostable materials, whereas other criteria such as economic viability and social impacts are often neglected, which can be misleading for consumer communication. In order to communicate sustainable packaging to consumers effectively, first the formal definitions and historical context should be explored.

The central concept of sustainability has been known for centuries. In food packaging, sustainability was applied in early civilizations and is used in modern civilizations in the context of preserving food until the next harvest season. The modern definition of sustainability has been formalized by organizations, corporations, NGOs, and policymakers and adapted to various fields. There are an estimated 300+ definitions for the term “sustainability” [12]. The emergence of the actual term “sustainability” is based on a 1987 United Nations report (Brundtland Report) defining sustainable development as “the development that meets the needs of the present without compromising the ability of future generations to meet their own needs” [13].

The concept of a more sustainable world has evolved as one of the most influential principles for continuing global development policies and comprises environmental protection and economic and social developments as core values [14]. Subsequent definitions and improvements have been summarized by Ishak et al. [15]. Agreement on a deep quantifiable definition of sustainable packaging is essential to be able to assess the relative sustainability of one package vs. another. Companies such as Coca-Cola, McDonald’s, Tesco, and others, also define sustainability and sustainable packaging

individually. This industry lack of agreement may be a partial cause of confusion among consumers, who already struggle differentiating sustainable packaging from other less sustainable packaging [4]. While many definitions of sustainability exist, only two concern packaging specifically. The definitions of sustainable packaging have evolved as shown in Table 1. Sustainable packaging was first defined as a result of a stakeholder survey study supported by the Sustainable Packaging Alliance (SPA) in Australia, which was formed to promote sustainable packaging and their implementation via science-based tools and strategies in the packaging industry [16]. SPA aimed to facilitate the development of sustainable packaging strategies suitable to Australia by engaging with key stakeholders [17]. Another definition of sustainable packaging that has been widely accepted is the Sustainable Packaging Coalition® (SPC) definition. The SPC is a stakeholder-based organization envisioning “a world where all packaging 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” (Sustainable Packaging Coalition®, 2011). Different than the SPA definition, the SPC definition of sustainable packaging makes a connection to renewable energy to produce more sustainable packaging. Specifically, the SPC defines more sustainable packaging to be produced using renewable energy sources including wind power and hydroelectric, biomass, and geothermal sources. SPC also recognizes the limitations of a full transition from fossil-based energy and materials to renewable counterparts. Each definition criteria should be assessed in relevance to sustainable development principles and should provide available opportunities for improvement. For example, according to the definitions, compostable packaging that is not developed using effective material and energy optimization and that does not meet the market criteria and profitability cannot not be considered sustainable, and its promotion as sustainable packaging would be misleading. The guidance on assessing the sustainability level of packaging or sustainability commitments can be obtained from multiple stakeholder-based organizations such as SPC or initiatives such as New Plastics Economy by the Ellen McArthur Foundation, The Ocean Plastics Charter, Circular Economy goals of American Chemistry Council (ACC) Plastics Division, Materials Recovery for the Future program, etc. [18]

Table 1. Evolution of the definition of sustainable packaging.

Origin of the Definition	Definition of Sustainable Packaging	Reference
Sustainable Packaging Alliance, Australia	1. Effective: “Reduces product waste, improves functionality, prevents overpackaging, reduces business costs, achieves a satisfactory return on investment (ROI)”	[16]
	2. Efficient: “Improves product/package ratio, improves energy, material, and water efficiency, increases recycled content, reduce waste to landfill”	
	3. Cyclic: “Returnable, reusable, recyclable, biodegradable”	
	4. Clean: “Reduces airborne, waterborne, and greenhouse gas emissions, reduces toxicity and litter impacts”	
Sustainable Packaging Coalition, USA	1. Beneficial, safe & healthy for individuals and communities throughout its life cycle	[19]
	2. Meets market criteria for performance and cost	
	3. Is sourced, manufactured, transported, and recycled using renewable energy	
	4. Optimizes the use of renewable or recycled source materials	
	5. Is manufactured using clean production technologies and best practices	
	6. Is made from materials healthy throughout the life cycle	
	7. Is physically designed to optimize materials and energy	
	8. Is effectively recovered and used in biological and/or industrial closed loop cycles	

Thus, packaging value chain definitions should be clearly communicated and defined. When producers are overburdened by cost and legislation and strict compliance requirements, a common understanding on shared product responsibility can be established to ensure uniform strategies through the entire value chain. Sustainability in packaging should, in principle, encompass the entire packaging value chain that extends from sourcing raw material and energy needed for packaging to post-consumer processing of packaging components. When considering the packaging value chain, material properties alone are not sufficient to provide sustainable packages. Packaging waste generation constitutes 29.7% of the total municipal solid waste [20]. A closed-loop system with inputs for resources such as raw materials (such as bauxite for creating aluminum cans) and energy that turns materials into packaging (such as that needed for pressing and rolling aluminum into beverage cans) and outputs of materials and energy exists. More sustainable packaging does not necessarily imply that packaging materials are regenerated for the same purpose nor that the same amount of energy is regenerated from them as was used to extract and process raw materials into the packaging. In general, sustainability principles are based on the need to manage the Earth's finite resources and apply shared value in managing these resources for current and future generations. In a more sustainable packaging system with a stable closed loop, energy and materials are captured and transferred for a viable purpose. Less sustainable packaging waste disposal options are considered to be landfilling, composting, degrading, and incinerating, although there can be tangible outputs such as carbon dioxide from composting and energy from incineration that can be captured.

Another important criterion to improve packaging sustainability is the assessment of the true environmental impact of packaging. The efforts by the paper, metal, glass, metal, and flexible packaging industry to assert their material as the most sustainable has led to consumer misconception and reinforced the misconceptions associated with improper visible package disposal. The implications can be several-fold.

First, life cycle assessment (LCA) tools to assess the relative sustainability of packaging should be used efficiently to cover as many environmental impacts as possible while focusing on specific packaging elements. Many LCA studies on materials do not consider all environmental impacts; however, interpretations based on limited elements are frequent. Full and simplified versions of LCA are available. Due to the detailed, quantitative, and cost-intensive nature of full LCAs, simplified LCAs (SLCAs) are widely used in the packaging industry. LCAs are commonly used in the eco-design during initial package development [21]. Examples of the commercially available tools are Comparative Packaging Assessment (COMPASS) by the Sustainable Packaging Coalition®, PackageSmart, Guide from Australian Packaging Covenant, and Packaging Impact Quick Evaluation Tool (PIQET). Moreover, many tools that packaging professionals use to estimate package sustainability lack complete inputs such as sustainable development (e.g., economic, environmental, and social impact) data. In addition, previous studies on sustainability assessments were either conducted qualitatively or could not be applied to specific packaging types (e.g., intelligent packaging) [22].

Secondly, interdependencies between packaging and products (i.e., foods) need to be analyzed and incorporated into sustainability evaluations and strategies for communication with consumers. Recent evaluations in the literature often include analysis performed from the food quality, safety, and food loss and waste perspectives. The impact of packaging adjustments extends beyond the material considerations, to improving shelf life and reducing food waste [11]. Critically, linking packaging and food waste within the United Nations Sustainable Development Goals Target 12 allows for the sustainability metric to be applied to both food and packaging waste. Decreasing consumer food waste and increasing recycling behaviors due to various packaging features can be incorporated in packaging LCA studies [23]. For example, optimized packaging was demonstrated to reduce waste in packaged foods such as sirloin steak, Bergbaron cheese, cucumber, yeast bun, and garden cress up to more than 10%, and food waste reduction due to package adjustments was found to be more impactful than the contribution of packaging in overall energy consumption [24]. When the indirect effects of consumer-package interaction are included, convenience features such as “easy to empty”

were found to be the most critical factor contributing to the environmental impact. This is because this feature decreases food waste [23]. The benefits of packaging, particularly active packaging solutions, on quality, shelf life, and food loss mitigation are evident, and informing consumers on the value of packaging technologies in reducing food waste and increasing sustainability is essential to develop a more sustainable food supply [11]. Another way packaging can contribute to a more sustainable food supply is by contributing to the reduction of food damage and losses throughout the supply chain. This reduced food waste is achieved by improved protection from distribution and extended shelf life for perishables. Despite the negative consumer attitudes toward packaging due to its highly visible environmental burden, research has demonstrated the potential of packaging to reduce the food waste. In a recent study, “packaging relative environmental impact” (PREI) in manufacturing particular food products was calculated from previously reported environmental impact studies [25]. In this context, PREI was defined as the ratio of the environmental impact of packaging to the overall environmental load. For example, PREI of various products showed global warming potential (GWP) units as high as 49–79% (soft drinks), 34.2–82% (wine), and 30–60% (canned tuna) and lower GWP for 1.2–6.5%, (beef), 3.3–13.9% (milk), 1.1–1.7 (cheese), and coffee (<3%). In that context, PREI is a function of both the environmental impact of packaging and the food. Figure 1 summarizes PREI data adapted from their work based on the product categories. The data points with a range were averaged for uniformity. Thus, products with the combination of high packaging environmental impact and lower product and processing environmental impact represent a less favorable or high PREI factor. This work can be used to focus efforts on reducing packaging that has a high environmental impact in relation to the environmental impact of food [25]. Furthermore, more effective and sustainable packaging is needed for products with a high environmental impact. For example, the production of animal-origin protein foods requires high energy resources with elevated greenhouse gas emissions and land use [26]; whereas, for a product with a lower PREI factor, food production and manufacturing become a driving force in environmental impact, as does the ability of packaging to maintain and extend the shelf life quality of food products. Regardless of the food type, glass or metal packaging materials represent a higher PREI; thus, strategies should focus on alternative materials, reduction, or geometry modifications [25].

One of the significant drawbacks of the packaging LCA studies is not incorporating the consumer behaviors from pre-purchase to post-consumption. Availability of quantitative data evaluating consumer interactions is scarce. This is one of the drawbacks to project learning from impact studies [23]. Incorporating economic, environmental, and consumer-related aspects such as LCA, life cycle costing (LCC), and consumer valuation by quantifying the willingness to pay (WTP), has been used to provide a consumer-based economic rationale for sustainability. For example, the sustainability of nanoclay-based polylactic acid (PLA) wrapped pork chops with sensors to indicate a flexible best before date (FBBBD) was assessed [22]. It was determined that the unit price of the FBBBD sensor should be lower than €0.05 in order to obtain acceptance with consumers. Lower probability of acceptance and WTP by the consumers occurred because the food waste was not internalized. However, compensation of the food losses was addressed if the FBBBD unit prices were lower than €0.02. They concluded that the most sustainable scenario would occur when the minimum price was combined with the maximum WTP by consumers.

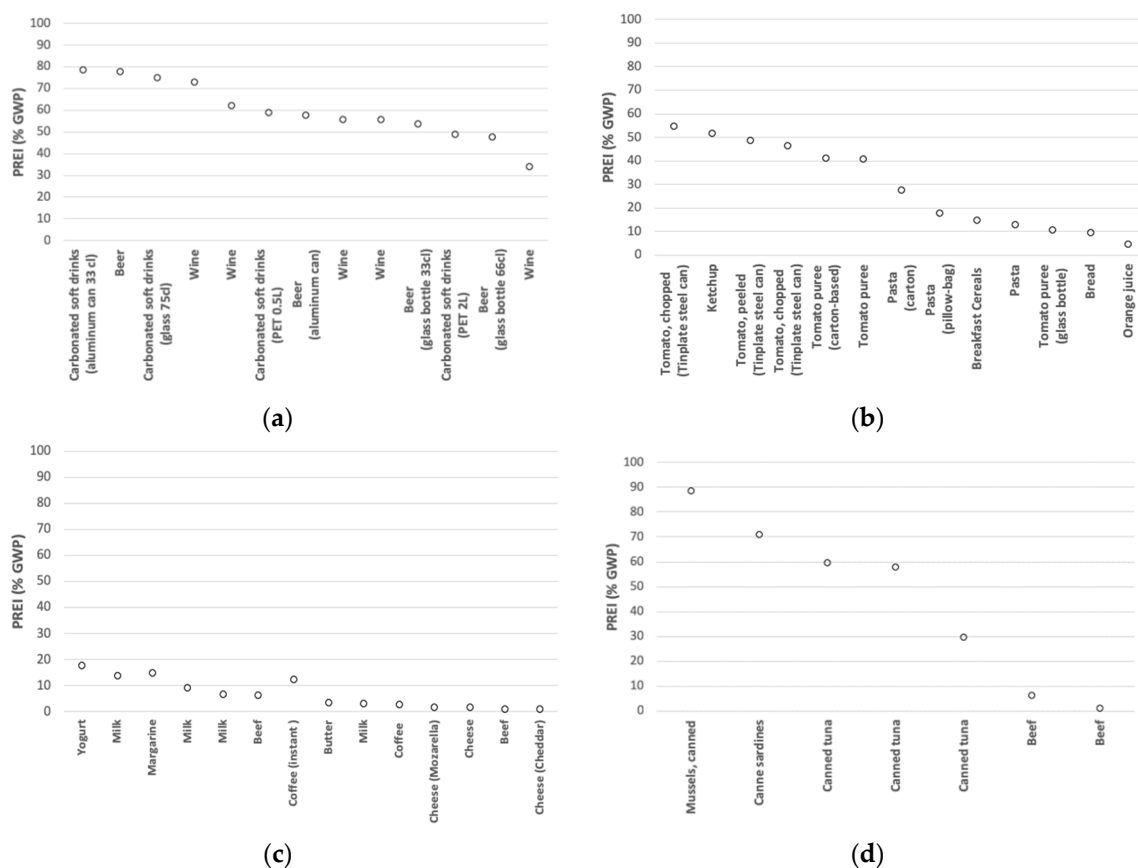


Figure 1. Packaging relative environmental impact (PREI) for beverages (a), raw and processed crops and vegetables (b), farmed and dairy products (c), and muscle-based products (d). Adapted from (Licciardello, 2017) [25].

3. Consumer Perceptions of Sustainable Packaging

After establishing a common understanding on sustainable packaging and its relation to the product in the entire value chain, communication strategies are ideally obtained in the design phase with feedback from initial descriptive consumer studies. However, biases and misinterpretations of the packaging elements by consumers can prevent success in the marketplace. Due to consumer misinterpretations, many on-label claims fail to deliver the sustainability message of the brands. On the other hand, studies on actual LCAs and consumer ratings of sustainability showed discrepancies due to preconceived notions on sustainable packaging. One of the reasons of such discrepancies is past greenwashing-inspired campaigns. Literature information on such issues are presented in this section.

Misinterpretations by consumers: Although sustainable packaging efforts are popular with many consumers, most consumers have misconceptions on sustainability in general [27]. From the consumer perspective, sustainable packaging can be defined as “packaging design that evokes explicitly or implicitly the eco-friendliness of the packaging” [3]. Even though the definition is within the context of sustainability, “eco-friendliness” is a broad term and does not cover the social and economic aspects of sustainable packaging. Definitions of sustainable packaging continue to evolve simultaneously with sustainable development principles. However, research has demonstrated that sustainable packaging is not communicated well to the consumers. For example, surveys have shown that consumers could not identify the sustainable packaging or did not have a clear idea of what sustainability packaging involves [28,29]. Consumers put more emphasis on a preconceived notion of what makes a package sustainable (e.g., recycling) while disregarding the remaining pillars of sustainable development—social and economic impacts. The social aspects are often left out of this equation. The social impact of sustainable development in packaging can involve both the principles of social justice and the consumer

demands on price, convenience, and performance of packaging [30]. As discussed earlier, critical to consumer research on sustainable packaging is that there are misconceptions about the meaning of sustainability. Therefore, purchase and post-purchase attitudes can be affected. For example, the concept of “bio” in packaging covering biodegradable and bio-based results in bioplastics is misinterpreted by consumers as being biodegradable readily in the environment, whereas most of the commercially available biodegradable polymers can only decompose in industrial systems under controlled conditions, and some bio-based plastics are not biodegradable [11].

Measured sustainability: Consumers make choices with inadequate information on sustainability, which is usually affected by cue inferring processes. Sustainable development of the packaging industry requires consumers to understand the results of life cycle analysis (LCA) of packaging materials and processes. Steenis et al. [10] investigated subjective consumer judgments on sustainability versus a more complete sustainability as measured using LCA. The research mimicked judgments consumers make while shopping. Based on consumer responses, a dry carton sachet was found to be least sustainable, whereas it had the lowest LCA impact (<5%). Similarly, even though a glass jar had a higher impact in LCA, consumers rated glass as the second most sustainable (42%) among all packaging materials. The same contradiction was seen in the comparison of bioplastic cups, which have a relatively high LCA environmental impact, whereas consumers rated them as highly sustainable. This contradiction demonstrates that consumer opinions on what is a sustainable package do not always align with the actual sustainability of a package.

Similar to the results obtained in the mentioned study [10], significant discrepancies between the results of LCA and consumers’ ranking of sustainable traits were found in the literature [31,32]. Consumers often rank the product based on packaging, and often glass and paperboard packaging are ranked as the most sustainable, omitting how the product was sourced or produced, which then does not encompass the total environmental burden. Consumers ranked glass, paper-wrapped, and canned peas as the most sustainable, whereas due to the origin of production (i.e., paper wrapped) and the material of packaging (i.e., glass), their environmental impacts were the highest [31]. The production part of the packaging is overlooked by focusing only on the post-consumption utilization mode to judge the sustainability of the packaging; reusable glass and plastics along with paperboard were ranked the most sustainable, whereas non-returnable plastics, plastic, and paperboard portions were perceived as the least sustainable. In another study, plastics, metal, and glass packaging all had higher environmental impact rankings by consumers, with metal and plastic packaging being the least sustainable options, which contradicts the LCA results [32]. This is a consistent message in consumer research and provides much direction.

Greenwashing: “Greenwashing” refers to a misleading claim (such as eco-friendly) or a symbol (such as a green leaf) or color (green) being used to convey that the package is environmentally more sustainable than alternative packaging. This is prevalent. For example, according to a report by Terrachoice, the amount of greenwashing marketing on labels increased by 200% from 2009 to 2010 [33]. Many misconceptions are a result of consumers being able to see the visible aspects of the actual packaging disposal since this is a directly observable phenomenon with appropriate (recycling bins) and improper (roadsides and waterways) disposal being in the public eye [7]. For example, plastic bags stuck in trees and paperboard fast-food cartons from litter of packaging is a small percentage of packaging. However, these are more visible than the high environmental impacts associated with, for example, glass bottle creation, collection, and recycling. Because the packaging material itself has a direct effect on the visible environment, it is interesting to note that the visibility of packaging itself might contribute to the sustainability perceptions of consumers. This knowledge can guide the design of advanced packaging systems to improve consumer decision making by encouraging consumers to make more sustainable choices. Consumer research developments in the ’90s have led to the application of behavioral studies incorporating sustainability into marketing efforts. While many package designs on more sustainable packaging sought to communicate this sustainability to consumers, efforts often resulted in ambiguous or fallacious “green” claims on product packages. For

example, creation of new words with no clear definition such as “TerraCycling”, which is often not more sustainable packaging, is confusing to consumers. The ability to connect package sustainability to sales has also led to misdirection of sustainability efforts within the packaged food industry. There has been a removal of greenwashing claims due to consumer backlash and questioning of misleading and inaccurate claims [33]. There is a real or perceived high risk in the promotion of sustainable packaging due to it being aligned with previously made false claims.

To avoid “greenwashing” accusations and potential for negative consumer feedback, many companies do not promote their efforts on more sustainable packaging to consumers. Greenwashing perceptions and distrust by consumers have caused the legitimate brands to lose their competitiveness and therefore become discouraged. For example, the use of only the color green in packaging without accompanying environmental cues negatively affected product perceptions for efficacy [34]. Consumers demand that the claims and branding in product packaging need to indicate the sustainability commitments and their connection to the brand. Green marketing failures were pointed out in a study as pricing the regular products as premium, relying on promotional aspects without product development, marketing efforts focused on compliance, and green-entrepreneurship [35]. This inability to communicate clearly to consumers has led to a lack of essential consumer decision-making information and created confusion on package sustainability and has not provided the ability for consumers to make fact-based decisions in countries in which extended producer responsibility (EPR) is not used. Interestingly, in the EU and other countries which have EPR mandates, consumers are provided with inherent and consistent information on the cost of packaging disposal (recycling, reuse, landfilling, composting, degrading) via the EPR process [36].

4. Consumer Behavior Theories on Sustainability

Marketing and consumer research have been utilized to drive sales and purchasing behaviors over the past several decades. Effective marketing and advertisement campaigns were founded based on consumer theories. As can be seen in Figure 2 from the number of research studies, explaining and predicting a consumer attitude (e.g., purchase) with behavioral concepts has gained attention over the past decade. This is a complex area that includes human behaviors and biases during purchase and at post-consumption, and sustainable packaging research has become common since consumer behaviors have the primary importance in purchase intentions. The confusion by consumers toward sustainable packaging can be addressed by considering the role of packaging in the value chain [30]. While this is true, there is a disconnect between consumer opinions versus the actions in environmentally friendly decisions and can be conflicting. For example, research suggests that when consumers make sustainable choices in one area, they will be both likely and less likely to choose more sustainable packaging. A value-action gap in recycling behavior was reported to be related to compartmentalized sectors and compensated behaviors. In the former, one sector of consumer attitudes, such as energy, does not necessarily transfer to another, such as recycling. This understanding provides direction that connecting more sustainable packaging is not always straightforward. This aligns with results in Steenis et al. [10], which showed that consumers have a disconnect between perceived and actual sustainable packaging. When compensated behavior was assessed, an excess in one area like green-transportation (e.g., biking to work) was often compensated by a non-sustainable behavior in another (e.g., not recycling a recyclable package) [37]. The most often studied and cited behavioral concepts in consumer studies related to the packaging value-action gap, metamotivation, and theories of reasoned action and planned behavior and social desirability bias are covered.

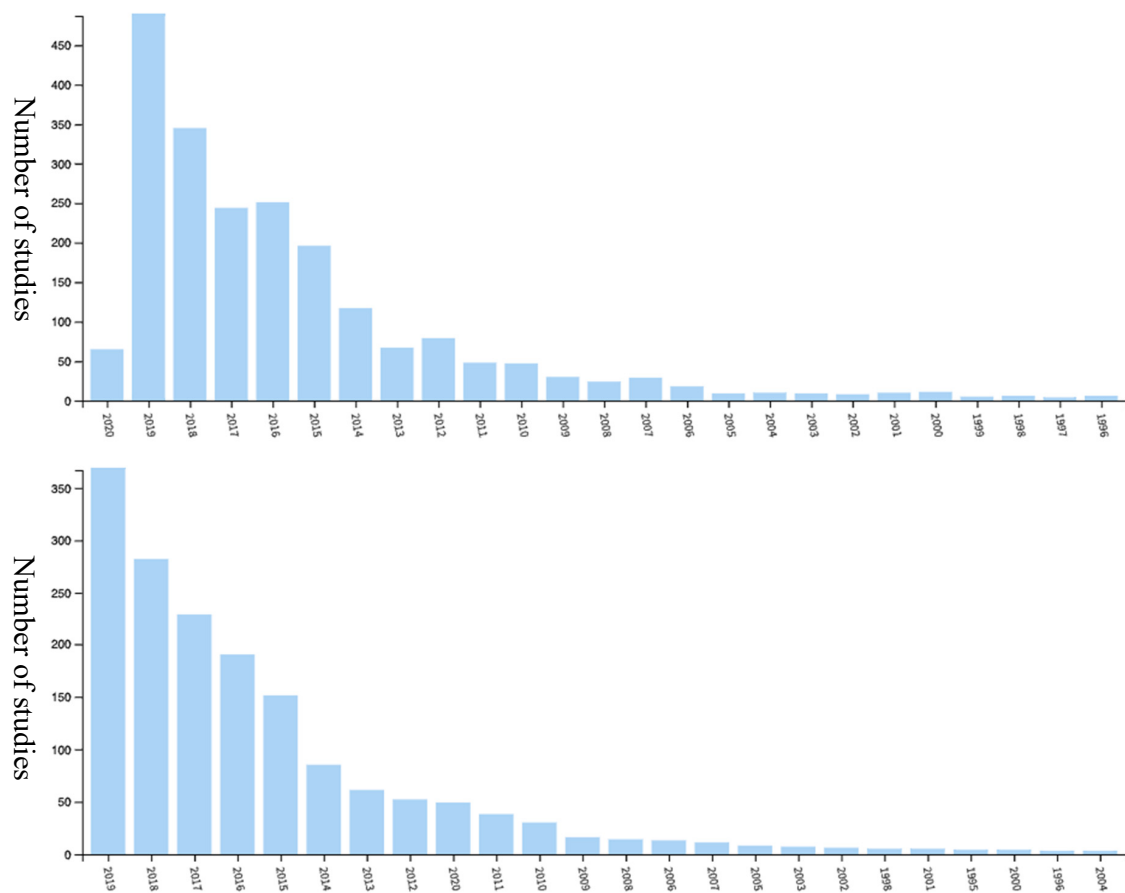


Figure 2. Number of studies with respect to years by including the keywords “consumer research” + “sustainability” (top); “consumer behavior” + “sustainability” (bottom) from Web of Science search on March 9, 2020.

Value-action gap: Some environmentally friendly packaging might also demand customers to trade-off on quality, performance, and price, which creates an “attitude-behavior” difference named the value-action gap [38]. Even if the consumers indicate preference during surveys, they might not purchase the actual product from the store related to economic, socioeconomic, and demographic reasons [39]. Thus, sustainability features of packaging might not always translate to a willingness to pay (WTP) [40]. However, when trade-offs were absent, consumers were more inclined to prefer environmentally friendly products [38]. This may provide direction as to why category-wide shifts to more sustainable packaging are more effective. For example, the recent concentration of laundry detergents was a category-wide initiative in which all laundry detergents were concentrated resulting in smaller size bottles and less plastic being used in packaging, as well as less energy being used in transport. Accomplishing this as a category removed the trade-off a consumer would typically have to make between smaller and larger size packaging at the same price, even though the problems emerged due to previous consumption habits (e.g., using similar volume of concentrated detergents to that of regular detergents). This suggests that sustainable packaging is often best achieved with category-wide initiatives. However, this contrasts with the pet food category in which Nestle Purina successfully launched a more sustainable molded pulp-based package. Consumers had to tradeoff between the product attributes as well as the more sustainable package. There may be category differences between the trade-offs of taste, health, and convenience between the diversely packaged food categories of candy, rice, beans, meat, cheese, yogurt, and soda. For example, in the crowded canned soda market, consumers decide the soda brand as well as a more sustainable alternative to a six-pack ring. An alternative to the ring is glue holding cans together, a degradable ring, a good ring, and PakTech HDPE

handles. This lack of converted category-wide effort results in consumer confusion since there are trade-offs besides the more sustainable package.

Metamotivation: Motivating consumers to adopt a specific, sustainable behavior is challenging due to the misleading perceptions and interactions among various factors. These misperceptions lead to choices being made not necessarily based on rational, sustainability principles, but with their own beliefs about sustainable products [10]. Attitudes and behaviors may be transferred between areas. For example, four out of five consumers stated that they show their environmental opinions through purchasing behaviors [41]. There are several theories and research available on the relationship between sustainability and consumer behavior including purchase and post-purchase attitudes. For example, metamotivation, a term coined by Maslow, suggests that once the basic needs (food, clothing shelter) are fulfilled, humans tend to care more about issues other than those which have a more immediate effect upon them [42]. As a result, after consumers have fulfillment of their basic needs, social and environmental causes, such as sustainable food packaging, become more relevant. Consumer research on the environment with consumer groups in which basic needs are met (e.g., price and taste) reflects that environmental issues related to packaging sustainability do indeed become a concern [7]. This is especially relevant to connect sustainable packaging to low-income consumers.

Barriers to sustainable behaviors: The cues of environmentally responsible behaviors can show in motivational, cognitive, and behavioral barriers. According to Valor (2008) [43], motivational barriers are created by personal and ethical identification are reflected in preferences of a person's area of interest (e.g., environmental responsibility or human rights). If consumers believe that their environmental purchase would make a positive impact on the specific issue, this drives the choice toward a more environmentally friendly purchase. Cognitive barriers are governed by the information available on the product or the company offering sustainable solutions, whereas behavioral barriers appear in time, cost, traveling distances, and other trade-offs [40]. It was shown that environmentally aware purchasing by consumers is affected by various factors including personal motivation and information available [44]. Likewise, research shows the presence of inhibitors or inconsistencies (e.g., lack of certain functional property in a product/package) might shift the behaviors to the opposite direction, and environmentally friendly options might become less-important [7]. For example, if features such as portability of a food package are stressed, and this portability is highly relevant to consumers, package sustainability becomes less critical in decision making.

Consumer switching behavior is complex, and consumer research that controls for product variables is needed. Birgelen et al. (2009) [7] studied consumer switching behavior toward "ecological" beverage packaging. In this study, while consumers were not willing to sacrifice on taste and price, they would switch brand, healthiness, availability, ease of carrying, and design for more eco-friendly packaging. Regarding met needs, this study showed that "ecological" packaging could create brand switching, while taste and price characteristics must be fulfilled. In the same study, the relationship between post-consumer package disposal and purchase behaviors of environmentally conscious consumers was assessed. Results suggest that for consumers for whom eco-friendly packaging is essential, post-consumer disposal is relevant.

Reasoned action and planned behavior: Various factors control people's behavior and motivation to engage in certain behavior. The theory of reasoned action (TRA) states that a person's attitude toward an object and behavior is related to the object [45]. For example, acting in an environmentally responsible way is a result of a person's intentions and views on environmental issues. However, TRA fails to address certain non-volitional factors such as income. In addition to TRA, when the effects of subjective norms and a person's perception of control over behavior are considered, it can be further explained by the theory of planned behavior (TPB). To illustrate, a person's own attitude and intentions toward sustainable products, cultural norms on sustainability, and the perceived level of difficulty of an action to engage in a specific sustainable behavior (e.g., price or availability) all contribute to an actual observable behavior (e.g., purchasing sustainable products or recycling). This concept is used in TPB to improve the prediction of particular observable behaviors, especially sustainable

ones. TRA has been used to predict healthful behaviors, organic food, energy conservation, and recycling, while TPB was empirically validated in eco-purchasing, recycling behaviors, and organic food selections [46]. TRA, TPB, and an extended-TPB considering the enabling role of TPB factors (environmental concern and purchase intentions) were compared. Results showed that extended-TPB was more effective in the predictability of purchase intentions of green products [46]. In this extended model, environmental concern was added as an additional measure. However, factors such as regional differences, demographics, and non-uniform cognitive behavioral patterns may create inconsistencies in using these theories in behavior prediction. Strydom [47] used TPB models to assess recycling intention and behaviors in South Africa. Households' perception of their recycling ability (i.e., perceived behavioral control) on recycling behaviors was well-explained by TPB, whereas it was less effective in explaining recycling based on households' intentions of recycling. Therefore, the authors suggested the need of additional variables governing recycling in the theoretical model and the need for more convenient recycling systems with less complicated curbside recyclable collections due to the revealed importance of perceived behaviors on recycling intentions. Despite its reported drawbacks, TPB is the most widely used measure to predict recycling behavior [47].

Spillover effect: Another concept commonly pointed out is the spillover effect, which can be defined as the effect of influencing a non-targeted behavior based on the engagement in another behavior [48,49]. Spillovers can impact non-targeted behaviors both positively and negatively. For example, a positive spillover effect can cause one pro-environmental behavior to improve or lead to another unintended pro-environmental behavior, such as actions of reducing fossil fuel footprints can influence the purchase of foods with bio-based packaging, whereas in the negative spillover, pro-environmental action in one area entails the elimination of the need for pro-environmental behavior in another area. These negative spillovers can occur, for example, when a person who prefers environmentally conscious living at home prefers to be non-environmental during vacation [49]. In a study by Lacasse [50], labeling consumers and their past decisions as "environmentalist" strengthened self-identity and positive spillovers and reduced guilt (i.e., negative spillover effect). However, the authors pointed out the shortcomings of using "liberal-leaning" respondents and the absence of a control condition in their study. The negative spillovers were also reported in cases of increased paper use when a recycling bin was present and increased energy consumption while driving hybrid vehicles [48]. The theoretical foundations of spillover effect are usually explained by self-perception, cognitive dissonance, and action-based learning theories. According to Bem's (1972) self-perception theory [51], which is the generally accepted theory to explain spillover effects [48], behaviors in one area are transferred to another to form attitudes and values; when people are prompted with pro-environmental principles, they tend to become more environmentally-conscious and make choices according to it. For example, consumers who were inclined to purchase environmentally friendly beverage packaging, tended to recycle and return the packages post-consumption [7]. It was commonly reported that positive and negative spillover effects could appear simultaneously, rendering the generalization of sustainable consumption behaviors limited [48,49,52]. The participation in waste separation and recycling activities was shown to improve packaging minimization, whereas committing to recycling decreased the tendency of feeling obligated to make sustainable behavioral changes (e.g., waste-minimizing product), indicating both positive and negative spillover effects [53].

Social desirability bias: Surveys are often used in determining consumer attitude and behaviors. One limitation with the survey-type studies is the social desirability bias, which requires respondents to state their thinking and not necessarily the way they act upon a particular decision [8]. Respondents describe a situation or themselves agreeably according to socially accepted norms, which can seriously affect the legitimacy of the studies. For example, consumers say they always recycle but do not always recycle. Since the issues such as sustainability are inherently delicate, the respondents are less likely to present themselves as un-sustainable [54]. There have been several strategies developed to point, reduce, or eliminate social desirability responding including scales (e.g., the Crowne-Marlow scale), indirect questioning, and bogus pipeline testing. The performance of such strategies is in question due

to their limited ability to distinguish bias in specific areas, bringing additional bias due to implied questions and being costly and ethically questionable [55]. For example, consumer WTP for packaging materials and recyclability were found to be 60% lower when indirect questioning was adopted, as compared to that from direct questioning [8]. Roxas et al. [54] presented the differences among different types of survey environment and modes: enumerator- and self-administered. The former method in which an interviewer conducts the survey tended to generate the internal attributes of respondents (e.g., self-identified characteristics such as sustainable and environmentally friendly) to a lesser extent.

5. Factors Related to Sustainability Perceptions

Even though there are various studies on consumer attitudes on packaging design elements, the number of studies assessing the effect of sustainable packaging on consumer decisions are relatively scarce. This lack of direction-oriented information may explain why, despite being highly promoted, sustainable packaging often fails to meet market projections. Moreover, sustainable packaging may not contain the product that consumers' desire or consumers might not want to switch from the familiar products to sustainable new packaging. Several factors that have been reported to be influential on consumer perceptions were presented in this section.

Demographics: The demographics including age, gender, education, and income levels may either have positive or negative effects on promoting sustainable purchase behaviors [56]. Consumer WTP for recyclability of the packaging of different materials including aluminum, glass, plastic, and paper was affected by demographic and socio-demographic factors such as age, political party affiliation, and limitations to recycling, including time-sensitivity [5]. They reported a higher WTP for older and younger consumers, whereas the respondents aged 59 had the lowest WTP among all age groups. Republican voters had a lower WTP than independent-leaning respondents. Education level affected the green purchase intention because of both the presence of eco-labels and environmental attitude. Gender affected the purchase intention due to eco-labels and human-nature orientation [56]. The study revealed that environmental attitude and eco-labels on the products improved the purchase intention for respondents with higher education; the effect of environmental attitude and human-nature orientation on green product purchase were also prevalent for females. In a consumer recycling study, women were more likely to recycle [37]. Similarly, in another study, women with an average age of 50 had the highest preference for environmentally friendly packaging compared to men [57]. In reviewed studies, women tend to engage in sustainable purchasing and disposal more than men and are more responsible for selecting the products in the household. Other than gender, the demographics do not seem to be relevant to recycling behaviors [37].

Country of origin: The differences in consumer behaviors on sustainability are also a function of the country and region of origin [23]. Many studies were conducted with consumers in different countries (the US, Portugal, Netherlands, China, Italy) and geographical regions within one country (the U.S.). The understanding of the term "sustainability" varied among countries and regions. For example, "environmental protection" resonated with more respondents in Germany, France, Spain, and the UK, whereas "maintaining a standard living" connected with Polish consumers [58]. Likewise, the top three expressions to explain the environmentally friendly packaging were "non-harmful," "biodegradable", and "recyclable" for respondents from South Africa [59].

There are country of origin-derived differences in views about post-consumer disposal of packaging. For example, consumer attitudes on the environmentally friendliness of packaging properties vary in the importance of recyclability, reusability, and biodegradability varied based on the country of origin [60]. In this research, U.S. consumers were found to value the environmentally friendliness of the package more than the consumers of France and Germany. This, however, may be linked to the general pattern of responses by U.S. consumers. The returnability and recyclability of packaging were more important for German and French consumers, respectively. U.S. consumers, as well, perceived recyclability as one of the essential traits of more sustainable packaging. German consumers among others were found to be the one who recognized the meaning of "biobased packaging". However,

because of the long-term EPR associated with packaging in Germany, consumers are inherently more likely to put more emphasis on the post-consumer stages. Consumers, regardless of the country of origin, had limited or no understanding of the impact of production, transportation, and retail stages of packaging as a function of sustainability. Furthermore, consumers were more concerned about the packaging end of life versus source [60]. Implications for the stakeholders including brand owners and regulatory organizations are often conflicting when considering costs, packaging performance, and supply chain management [61].

Empirical results suggest that high-income countries are usually more environmentally concerned than low-income countries [46]. The amount of research on consumer attitudes as a function of low, lower-middle, and upper-middle economic status are scarce. However, these economic groups drive consumer behaviors, and their attitudes need to be understood to enable sustainable packaging to best align to resonate with these consumers [59]. For young Indian consumers, price, utility, and convenience of packaging were the most important factors for the perception of the product. Interestingly, non-vegetarian consumers were more environmentally concerned than vegetarian consumers [62]. Malaysian consumers had little knowledge on eco-friendly packaging, and the decisions of the majority of the respondents were affected by the packaging design [63]. The implementation and promotion of environmentally responsible principles and sustainable packaging by policymakers and industry are limited. Moreover, when these efforts are combined with limited infrastructure, it is even more challenging to improve sustainable post-consumption behaviors such as recycling. For example, a study conducted on recycling habits of South African households indicated that 73.1% of the households in large urban areas did not recycle due to limited systems and that less complicated and more convenient garbage collection systems would have the highest potential to encourage household recycling rates [47]. Similar results were obtained in another study where 45.6% of the respondents said they reuse packaging whereas only 30.1% recycle [56]. In this study, consumers could not identify the reusable and recyclable packaging. Interesting packaging mitigation strategies were given as promotions through TV, media, and giveaways, on-label information regarding the implications of sustainable pre- and post-consumption behaviors and eco-labeling with third-party accreditation [59]. Third-party certification labels were found to be effective in positively influencing purchase intentions and reducing the perceived risk for sustainable products, especially when the certifications were credible [64].

In a consumer study for the assessment of “green” food purchasing of Swiss consumers, the socio-economic factors including education and occupational level, employment status, and household income were not the significant predictors for green purchases [65]. However, in another study that investigated consumer characteristics (personal values, age, gender, education level, country of origin on motivation, and understanding of the sustainability information presented on the labels), education was a relevant predictor among other characteristics such as age and country. Country of residence also affected the concerns toward sustainability issues on the labels, with the highest and the lowest concern in Spain and Sweden, respectively [58]. Differences in use of the label information when purchasing a product is also a function of the country of origin.

To conduct cross-national consumer surveys, one concept to consider is the response styles of participants from different countries and nations. A study assessing the response styles of participants from 26 countries revealed that the surveys conducted in different countries showed varying response styles, and the surveys in English and participants’ native language generated average and extreme responses, respectively [66]. In the same study, geographic similarities in response styles between different countries and differences within the same region were also found.

Norms and values: Role identity—personal or social—has been investigated as a determining factor explaining sustainable behaviors. For example, under the theory of planned behavior, participants were inclined to engage in recycling behavior if the activity of recycling was an essential part of their self-identity [67]. It was determined that a significant relationship between the intentions and the social norms of the respondents existed only when the person identified themselves with the

reference group, highlighting the importance of group membership. The higher correlation between the consumer self-identity and the group norm was seen only when the group norm was perceived as “pro-recycling.”

On the other hand, self-identity was a strong predictor of a recycling intention, an increased motivation to recycle, when the person considered recycling as an important component of their self-identity. Thøgersen [68] studied the influence of moral norms on preferring environmentally friendly packaging at purchase; the person’s own environmental concern constitutes the moral reasoning to purchase. Moral reasoning and compliance with expectations that the consumer perceives affected the preference of reduced-waste packaging. Furthermore, personal norms were found to be dependent on perceived social norms. Onel [69] studied the impact of personal and subjective norms on pro-environmental purchase intentions; they demonstrated the importance of personal norms (i.e., self-expectations associated with their environment) rather than subjective norms. A group of predisposed participants who were the members of the recycling program of TerraCycle were used to fulfill the condition for pre-activated personal norms in the study. However, the authors argued that generalization of the results to the whole population might be limited due to the respondents’ involvement in recycling-based programs. In another study, respondents were not affected by the social pressure for sustainable packaging purchasing and disposal behaviors, and their perception for control of solving the packaging waste problems was found to be weak [57].

Package design: The cue utilization process entails the judgments of a feature based on another feature; for example, taste decisions based on the color of packaging provide a cue for the consumer in the testing and likewise while shopping [70]. However, in some settings the number of cues can be combined with controlled time to recognize cues using short consumer attention spans, leading to unidentified cues and relying only on salient ones [10]. This focus can create results with high variability since the methods rely on cues identified by consumers and the time to register cues varies for consumers. The cues on packaging for consumers can be constructed by using verbal, structural, and graphical attributes. Graphics and colors are some of the most widely used cues in packaging design to signal sustainability. For example, green graphics and colors are indirectly considered as environmentally friendly [29]. Verbal communications such as claims and statements on packages are also employed to communicate sustainability [34,71]. The product efficacy perception declined when an eco-label or green color was used alone on the label compared to a different color with no label for consumer products; when the color green was used alone, it indirectly correlated with perceived lower product efficacy, and likewise, purchase intention declined [32]. When the eco-label was added to the green-colored packaging, this negative effect decreased.

Visual characteristics such as package size, color, shape, label, and graphics, as well the product itself, can also imply sustainability of the packaging [34,71]. The initial categorization of the product by consumers, whether or not it is environmentally friendly, determines the following evaluations of products within the same domain [34]. Understanding how attitudes in one area (such as package design) can transfer to another in terms of perceived package sustainability is a critical step to create such behaviors [72].

In the qualitative area of the study, among 3224 categorized cue perceptions, which included the material, shape, transparency and form of the package, convenience, sustainability, novelty/conventionalism, and quality were salient with 382, 293, 263, and 189 cue perceptions, respectively [10]. The results of this study have demonstrated that the sustainability concept may not be well known by consumers, who rely on their own lay beliefs about such issues. Although the limitations included the use of solely a student sample, use of a simulated real-life purchase setting and environment, potential brand, product, and graphics, and randomization of the stimuli, results unequivocally demonstrated that consumer perception does not align with what is actually more sustainable packaging. The effect of various packaging designs and their connection to functional and price characteristics, which then was compared to sustainability, determined the rank of sustainability among other features [10]. In this research, traditional graphics were compared to graphics with the

appearance of green leaves to invoke sustainability thoughts in tomato packaging made from different materials (e.g., bioplastic, can, carton, glass) and forms (e.g., pouch, brick, jar). Oddly, conventional tomato soup graphics were identified as modern and familiar, whereas the design with greens designed to appear more sustainable was associated as traditional. Rigid packaging had a higher protectiveness score than flexible ones, and packages made from bioplastics and dry carton had the highest and lowest sustainability scores, respectively.

In a conjoint analysis group preference study with 94 people [40], aesthetics, price, and functional attributes of packaging including water bottles and spoons were found to be different before and after the environmental metrics were included. Even in sustainable product evaluations, the form of the product remained as one of the most essential characteristics. However, Martinho et al. (2015) [57] found that packaging design was not as important as product quality, sustainability features, and price of the product.

On-label claims: Magnier and Schoormans [71] assessed the visual and verbal claims regarding the eco-friendliness of detergent and mixed nuts packaging and their influence on the attitudes and purchasing intentions of consumers from two different countries (the Netherlands and France). The authors also included non-student test groups (commonly used in consumer research) and found that consumers with high environmental awareness were perceptive to verbal claims and the appearance of the packages, and the consumers with low environmental awareness were not sensitive to appearance or verbal claims. Another application in the UK is voluntary carbon-footprinting and labeling of foods to inform consumers about the aim of decarbonizing in food use. Gadema and Oglethorpe [73] found that 72% of the surveyed consumers preferred carbon labels, however, 89% were confused by the information provided on the label. The authors suggested not solely relying on consumer preference, which can also create guilt, when products with higher carbon footprints are purchased but, rather, embarking on the idea of finding effective initiatives between policymakers and food supply chain members.

Price: In previous consumer research associated with green products and environmentally friendly packaging, price was often pointed out as the barrier and influencing factor for purchase intentions [56,57]. The effect of price, product quality, packaging functionality, and packaging design was assessed versus the purchase of sustainable product packaging and recycling among the consumers who initially self-identified as environmentally aware and neutral on such issues. A previous study [7] showed that taste and price were the primary determining factors of purchase. This demonstrates that sustainable packaging needs to be comparable in price or that EPR can be employed to define higher costs of disposal for less sustainable packaging [57]. However, due to material differences, manufacturing, processing, and supply, converting to sustainable packaging can be more expensive for food manufacturers. The number of people indicating an energy-saving behavior at home and the number of consumers who would pay a premium for green products are in decline. This indicates an emerging resistance of consumers for premium price possibly in response to “over-hyping” green movement and claims [74]. Interestingly, the premium price (20-30% higher) did not influence green product purchase intentions as a function of consumer environmental view or presence of eco-labels and WTP for environmentally friendly products [56]. The authors pointed out that the widely reported effect of premium price was non-existent due to the higher income levels of the respondents in the study.

Product factors: More sustainable chocolate, raisins, and coffee packaging increased consumer product quality perception. Interestingly, more sustainable packaging did not have an additive effect on perceived product quality and sustainability indicators (e.g., organic) when the quality of the product was cued in the survey [61]. This means that sustainable packaging enhances the quality perception of chocolate but does not enhance the quality of organic products. This alignment with chocolate quality could be because the organic element dominates, and consumers will trade off sustainable packaging for organic chocolate.

Research suggests that consumer perception of sustainable packaging is dominated by material selection vs. product protection. Eighty-three percent of consumers stated that material selection had

the highest environmental impact, whereas criteria such as food waste, refill, or transport efficiency had little or no impact (1%) [28]. This knowledge indicates that consumers in this study saw little value in a food package to provide product protection that would inhibit food waste or provide efficiencies and result in an overall more sustainable product-package system. Interestingly, since consumer food waste is about 30% post-purchase, this decision impacts the value of consumer spending on food. However, when assessing the most important feature of an environmentally friendly package, respondents selected packaging materials. In this same study, metal and plastics-based materials were not environmentally advantageous whereas paper-based packaging was perceived as environmentally friendly. This material-based perception agrees with previous research which demonstrated that consumers had a misunderstanding of what sustainable packaging entails.

Overpackaging: Chen et al. [75] assessed the effect of excess packaging on an environmentally friendly green brand image and consumer attitudes. The results suggested that overpackaging did not have a direct effect on green brand attachment. However, consumer view on green brands governs the negative attitude toward excess packaging and the attachment for the green brands. Overpackaging is a sensitive subject for products with private labels since the brands have the options of reducing or eliminating overpackaging and position with a sustainable development image, while risking the brand image and consumer acceptability [76]. In a study aiming to assess the impact of overpackaging on consumer perceptions on quality, expensiveness, environmental friendliness, and convenience of private label products, purchase intentions were monitored. Perception of environmental friendliness and expensiveness increased whereas convenience decreased with the elimination of overpackaging [76]. They also pointed out that perceived quality decreased for only private label products. A strategy adopted by Danone when the over-cap on the Activia brand was eliminated was to strengthen the primary packaging by making the lid material stronger and the added convenience of just one lid to remove was communicated to consumers.

6. Packaging That Improves Sustainable Post-Consumption Behaviors

Packaging can also contribute to sustainable behaviors of consumers including post-consumption behaviors and increased perceived value of packaging due to enabling such behaviors which can be affected by consumer- and packaging-related factors. Available literature mostly focuses on changes in consumer WTP associated with improved recyclability and general attitude assessment with post-consumption behaviors. This section highlights the research focusing on the intersection of sustainable packaging and post-consumption attitudes of consumers.

The increasing popularity of sustainability principles has not always been closely associated with ecological behaviors such as recycling habits [77]. A U.S. Environmental Protection Agency (EPA) report states that the total recycling and composting rates of generated packaging and containers increased from approximately 10% in 1960 to 26% in 1990 and slightly over 53% in 2015 in the U.S. [78]. These rates are behind other high-income economies, for example, Belgium (81.5%), Ireland (67.5%), the Netherlands (67.5%), Germany (69.3%), and France (65.5%) have recycling rates (i.e., without incineration and other recovery methods) respectively [79]. The data is based on the official reporting of the EU Member States by considering paper and paperboard, glass, plastic, wood, and metal. Figures 3 and 4 show the distribution of the material type of the collected waste and the packaging disposal, recycling, and recovery rates in the EU, respectively. These goals align with the EU goal of at least 55% of packaging waste (weight) recycling by 2008 [80]. Furthermore, the data show that 66% of recyclable packaging is not recycled in the U.S. This contrasts with 35% of non-recycled recyclable packaging waste in the EU [60]. According to a report by the National Resources Defense Council (NRDC) less than 15% of plastics packaging, which is the fastest growing segment of packaging materials, is being recycled in the U.S. [81]. Even though the total amount of packaging increased, the percentage of the recycled packaging remains nearly constant at 14.6% since 2000. In addition to country of origin, such phenomena might also differ with various internal and external factors including demographics, disposable income, infrastructure for recycling, incentives, and available information [37,82]. Based on

the Simmons National Consumer Survey, 71% of U.S. consumers state that food packaging materials should be recycled and 68% of consumers say that they are intentionally making an effort to recycle materials such as paper, glass, and metal cans [83]. To align with consumer stated interest in recycling and the corporate statements to employ recyclable packaging materials, knowledge of key drivers for the consumer to recycle food packaging and for municipalities to enable recycling is needed. This is complex research. However, it is essential to investigate the motivation behind the ecological behaviors of consumers to extract advantages such as improving sustainability decisions during pre- and post-purchase of packaged products.

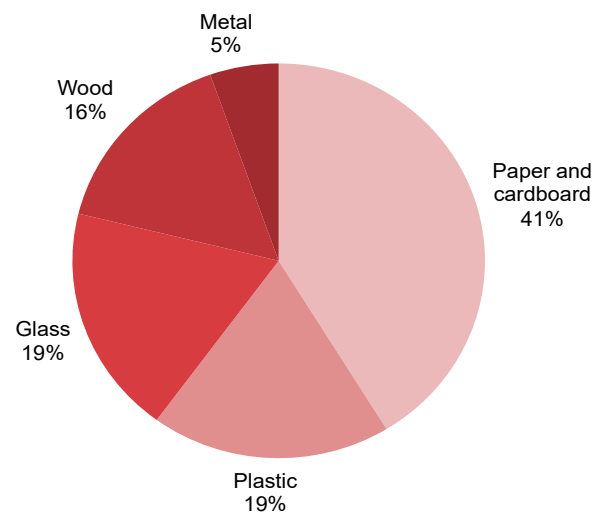


Figure 3. Packaging waste collected as a function of material type in the EU in 2015 (Eurostat, 2015).

Share of treatment of all packaging waste, 2015 (%)

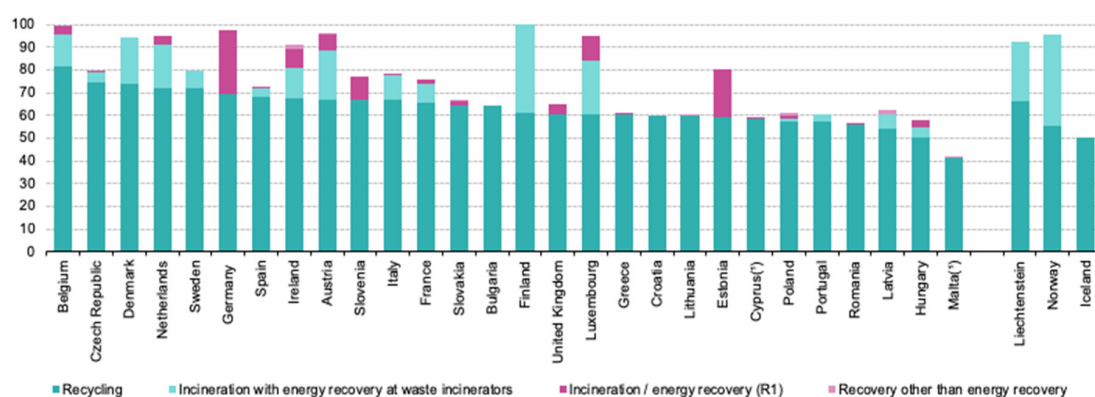


Figure 4. Differences in packaging waste disposal, recycling and recovery rates of European countries [79].

Birgelen et al. [7] assessed the purchase and post-consumption disposal behaviors related to beverage consumption and environmental awareness with German consumers. They found that eco-friendly purchasing and disposal decisions for beverages are related to the environmental awareness of consumers and their eco-friendly attitude. Furthermore, consumers were willing to trade off almost all product attributes in favor of environmentally friendly packaging of beverages, except for taste and price. They also found that the consumers who wanted to purchase environmentally friendly beverage packaging were leaning towards recycling the packages or returning them to the store.

Research shows that material-related properties are the structural cues used to invoke sustainability for consumers. Previous research mainly focuses on recycling practices, not specifically on the recycling of different packaging materials. Consumer WTP was assessed for different packaging materials (i.e., glass, aluminum, carton, and plastic) with a binary option of recyclability and WTP values for 12 oz single-serve fruit juice products by [8]. Packaging made from plastics, glass, carton, and aluminum had WTP rankings from the highest to the lowest, respectively. The density function of the recyclability and willingness to pay for aluminum-based packaging after respondents watched a video on the benefits of aluminum recycling increased the WTP. This suggests that information is a compelling factor for changed consumer behaviors. Unfortunately, consumers are receiving conflicting sustainability information. In the same study, it was revealed that recyclability utility for plastics materials had the highest WTP, suggesting that consumers believe that recycling for plastic packaging is the most sustainable. It was found that recycling motives (e.g., improving water quality) had a high impact in WTP responses, and demographics were not found to be correlated with the actual behavior of recycling [8]. Interestingly, states where there are incentives for bottle return did not have higher WTP. This implies that consumers are becoming accustomed to expensive bottle prices or low deposits offered for returning packages [8]. Another important finding of the study was that consumers with high time-sensitivity were inclined to pay less for recyclable packaging.

7. Research and Testing Methods on Sustainable Packaging Consumer Research

In behavior studies, understanding of the preferences for environmental alternatives made by individuals or groups is limited [40]. Before the design and implementation of sustainable packaging strategies, robust consumer testing simulating target consumer behaviors is needed. Several methods have been developed for evaluating consumer preferences such as conjoint and discrete choice analysis encompassing the identification of continuous and discrete properties [40]. Lacking simultaneous measurement of visual and descriptive stimuli and adding an environmental impact variable for products as an independent variable in discrete analysis are some of the limitations associated with the consumer studies on sustainability features of products [40].

The research method used to determine the impact of sustainable packaging on consumer preference for sustainable packaging involves general attitude-related models, holistic perceptions (consumer perceptions and sign-based communication), and analytic methods to assess the effect of specific design cues [10]. In general attitude models, the attitude of consumers towards sustainable products are directed by perceived behavior according to the theory of planned behavior (TPB). For example, a person's own behavioral factors such as environmental consciousness and knowledge are the driving forces of a chance to contribute to a solution for an environmental issue such as packaging waste [57]. These approaches often incorporate test methods to determine consumer inclination towards sustainability-related purchasing and post-purchase behaviors and measure neither a specific design element nor the importance of sustainability to consumers [10].

In holistic approaches packaging characteristics are assessed as a whole without considering single elements separately. The principle is based on the idea that packaging is constructed with many elements combined and invokes an attitude or behavior together. Results found using this method indicate that material cues are used when making an assessment of the sustainability of packaging. Interestingly, the type of packaging materials was not mentioned in answers [28,29]. Conjoint analysis, commonly used in psychology and economics, is based on creating a utility function using the data collected from a survey-type analysis. Aesthetic assessments combined with optimization frameworks have also been developed. Analytical approaches comprise isolation of specific characteristics of the sustainable packaging. Therefore, it is more realistic to the actual on-the-shelf consumer purchase conditions. The cues analyzed previously include color and labels [10,71], single-multi serve packs [84], and transparency [85]. Studies that investigate the effect of individual environmental characteristics of packages are limited but effective to determine behaviors [86] and purchase attitudes [34,61,71], as well as the relationship between sustainable components and functional and price characteristics. The

analytical methods in previous studies show that sustainable features incorporate graphical or verbal stimuli. Structural elements (e.g., material type) are required as well [10].

In addition to the several approaches for consumer testing on sustainability, the setting of the test can be a determining factor. The setting of the consumer research test environment also has an impact on results. Care should be taken before transferring the results of the studies in which consumers respond to a questionnaire rather than in an observable purchasing activity. To determine the pro-environmental behavior of consumers, an ideal setting would simulate a purchasing behavior [7]. The test group also needs to be a representative subset of the target group. For example, consumers who have attained a high education level tend to respond favorably for environmental aspects of packaging, and screening respondents as a function of their educational level might be critical [58].

Klaiman et al. [8] found that indirect questioning had 60% lower willingness to pay (WTP) than that of direct questioning and video exposure affected results as well. Discrete choice experiments (DCE), based on Lancasterian theory [8] and random utility theory [87], are commonly used in this analysis and usually several individual or general attributes are assessed with levels of choices and ratings. Lancasterian theory entails focus on the choices made from the features of products, rather than the products themselves, while random utilization theory assumes unknown consumer utilities (e.g., budget constraints) as random variables. DCE assessment points out imperceptible traits of products by carefully selecting features that are expected to influence consumer decisions. A standard method to model preferences is an estimation of random parameters logit (RPL) (i.e., mixed logit) via utility function [8]. For example, consumer demand for recyclability of packages increased due to additional information available. In this case, self-response to exposure to information and the questionnaire brought about social desirability bias of recycling.

8. Case Studies

This section covers three case studies based on corporate research projects conducted on sustainable materials and packaging communication with consumers.

8.1. The Analysis of Consumer Attitudes on Sustainable Materials by Value Perceptions

Research Question and Methodology: In the first case study, packaging labeling for a cellulose-based flower pouch was evaluated against a Polypropylene control sample applying the Value Toolkit®, a tool developed for evaluating consumers' packaging value perceptions [88]. The research question asked if the branded logo and sustainability information of the cellulose-based material would affect consumers' value perceptions, willingness-to-pay (WTP), and likelihood-of-purchase (LOP). During the first evaluation round, consumers were asked to match a set of pre-defined value attributes with two PP samples along with stated WTP and LOP. Next, packages with the brand logo and some verbal information on cellulose-based material were presented to assess the same set of value attributes, WTP, and LOP. Fourteen female participants with an average age of 44, who stated interest in environmental issues and sorted packaging waste regularly, were selected to participate in the study conducted as two focus group discussions.

Results: Figure 5 presents the highest differences in the attribute ratings between samples with PP and cellulose-based pouches. The top three largest increases were measured for organic, easy-to-recycle, and nature-friendly for both designs. With the dark green design, the WTP for the PP pouch was 5.26€ and 5.55€ (+0.29€) for the cellulose-based pouch. With the light green design, the WTP was 5.45€ and 5.65€ (+0.20€) for the PP and cellulose-based pouch, respectively. With the PP pouch the average likelihood of purchase for the dark green design was 5.8 and for light green 5.5 (range 0–10). When the cellulose-based material was introduced, the likelihood of purchase for the dark green design increased to 7.0 (+2.2) and for light green to 6.0 (+0.5).

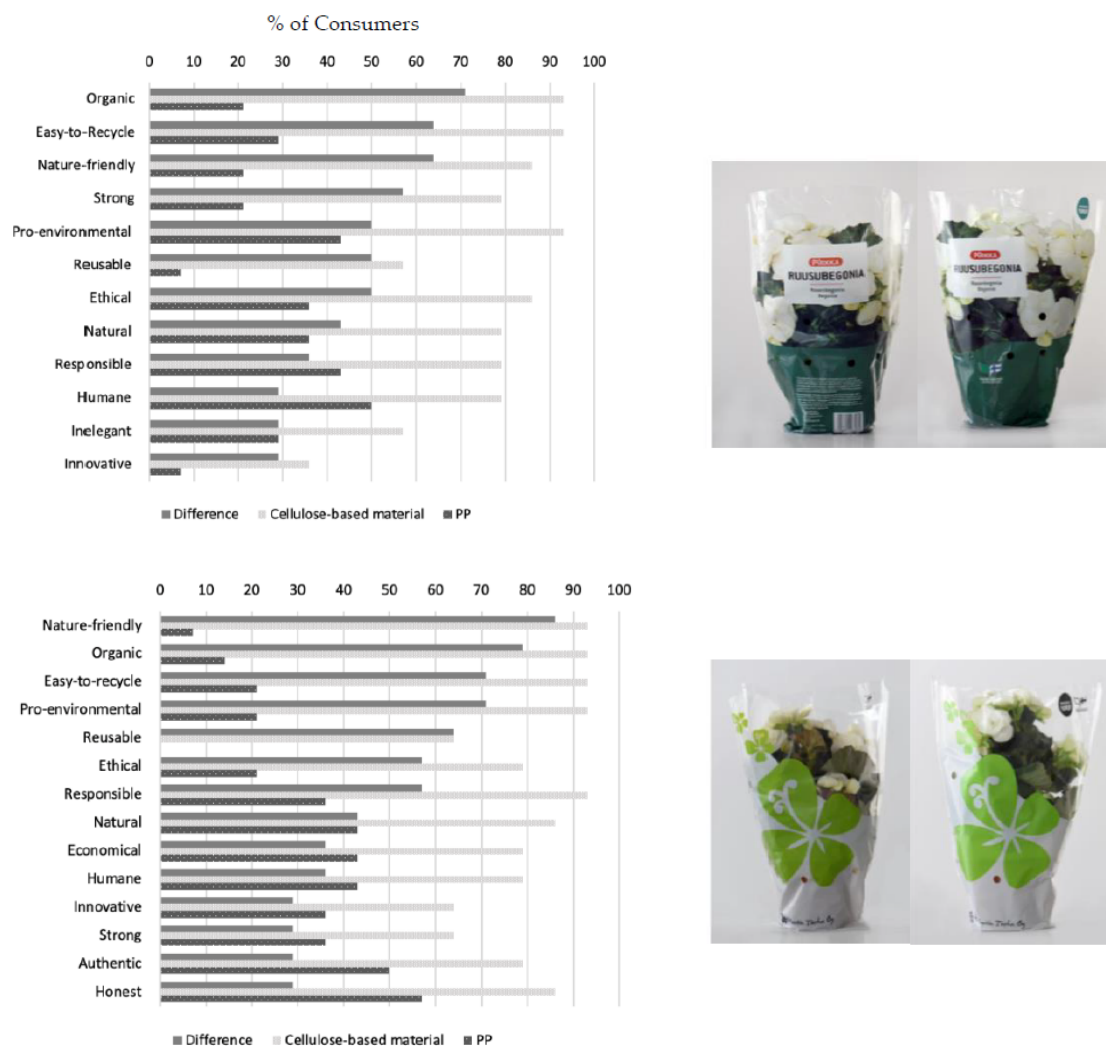


Figure 5. The largest attribute differences between Polypropylene pouch and cellulose-based pouch in consumer ratings.

Therefore, cellulose-based film resulted in both higher WTP and LOP for consumers. During discussion, participants who stated that their WTP would not increase said that the bioderived material would provide a competitive advantage if priced the same as the PP pouch. On the other hand, some participants stated they would be willing to pay more if the labels were more informative. Several key questions from the participants were posed regarding the production sustainability of the cellulose-based material and its recyclability. Consumers also stated the branded logo may be associated with the packaged product and should be supported with additional information on the label referring to the packaging material.

8.2. Making the Connection Between Sustainable Packaging and Brand Identity

Sustainability logos and labels: This case study was conducted via a collaboration of PackageInSight with Clemson University [89] where package performance, consumer attention, and the shelf impact were studied. The sustainability rating logos were created using QuadPackaging and PackageInSight and were printed on five different generic brands from frozen food, pasta, beverage, snack, and medical product categories created at the Clemson University CUshop retail laboratory. During tests, participants shopped in two groups of 30 (60 total), and the results were statistically analyzed with ANOVA. Parameters such as purchase decision (PD), total fixation duration (TFD), time to first fixation (TTFF), and fixation count (FC) were measured using eye-tracking technology with a data recording

speed of 50 times per second. The participant demographics were screened and were found to be parallel to a typical U.S. household shopper's profile, that is mostly female, employed, married, with at least a bachelor or graduate degree. The main research question was to see if the consumer decisions were affected by sustainability logos and labels and to determine if the addition of a sustainability rating logo improves consumer attention and sales.

As a result of the eye eye-tracking technology, 92% of the participants did not notice the sustainability rating logos, despite more than 40% of the participants stating that their purchases were affected by sustainability concepts. Food and beverage packaging and household paper goods were the top three categories consumers claimed to think about regarding sustainability. Even though the packages with sustainability logos performed better during TFF tests in snack, healthcare, and pasta categories, there was no statistically significant difference. The TFD and FC values were better in health and frozen meal packaging with sustainability logos. According to the results, the case study highlighted two recommendations: (i) the need for consumer education on a company's commitment through integrated marketing channels, (ii) placing the sustainability logo in an additional location to complete the integrated message of the brand.

Consumer education: The second part of the case study explored the effect of consumer education on sustainability logos and labels on consumer attention during shopping and sales [90]. Previously created sustainability logos were placed on educational flyers showing the sustainability grading system and a brief definition of sustainable packaging. In this part, faux brands with sustainability rating logos were compared against nationally known brands with the same logos with the same product categories. This method was employed to eliminate the disadvantage of nonexistent brand recognition on sustainability logo recognition. Participants assessing faux brands received educational flyers before shopping for products, whereas the other group did not.

As a result of the influence of prior education on sustainability, a 44% increase was seen in the number of participants who noticed the badge with a 50% increase in sales. The TFD values for the frozen meal, water, and pasta were better in faux brands with educated participants. Similarly, the faux frozen meal brand with a sustainability logo had a higher FC value and outperformed the national brand.

9. Discussion and Future Perspectives

As discussed, communication of more sustainable packaging to consumers is problematic. Furthermore, if food packaging suppliers and companies are directed solely by consumers' opinion of sustainability, the most sustainable packaging alternatives will not be employed because consumers do not always select the most sustainable package. If instead, food packaging companies employ more proven sustainable packaging and this packaging is clearly and meaningfully communicated to consumers, it will be embraced. Leadership in realizing opportunities and communicating with consumers about sustainable packaging as well as consumer research to determine how more sustainable packaging can resonate with consumers is needed. Before the design and implementation of sustainable packaging strategies, robust consumer testing with the target consumer is needed. Research methods used to determine the impact of sustainable packaging on consumer preference for sustainable packaging involves general attitude-related models, holistic perceptions (consumer perceptions and sign-based communication), and analytic methods to assess the effect of specific design cues. In the following part, opportunities, research needs, and strategies are summarized. Table 2 also outlines these opportunities. Importantly, the ability to connect with consumers on more sustainable packaging will enable the business case needed for the implementation of more sustainable packaging.

9.1. Opportunities

1. Build a business case for more sustainable packaging. Metamotivation research demonstrated that when consumers receive tangible information on sustainability, they act more sustainably. Providing consistent, tangible information is key to motivate consumers to switch to a more sustainable

package. For example, voluntary carbon-footprinting (UK), How2Recycle labels, and EPR fees linked to packaging disposal guide consumer decision making in a meaningful manner. Agreed-upon uniform assessment tools, such as this to gauge the sustainability of a package, are necessary to communicate sustainability to consumers.

2. Gain insights from countries in which high group sustainability norms result in high recycling rates. In the US, 66% of recyclable packaging is not recycled. In the EU, where high sustainability norms exist, only 35% recyclable packaging is not recycled. Applied efforts on how to create group norms of recycling and proper disposal are needed.

3. Align municipalities and businesses with regulations, by directing suppliers, developing sustainable products and services and new business models, and creating best practice platforms.

4. There is an opportunity to connect sustainable packaging to low-income populations. Two hundred and seventy-five million tons of plastic waste was generated by primarily low-income coastal countries [91]. Ten rivers—two in Africa and the rest in Asia—discharge 90% of all plastic marine debris, with the Yangtze River alone carrying 1.5 MT a year.

5. Monetize sustainable collection and sorting and provide jobs and income as well as add innovation in efforts to fuel the circular economy in low and middle-income regions.

6. For small and medium-sized companies, the packaging is not regarded as a major issue, and packaging systems are not reconsidered and updated in the light of advances in materials development. The fact that packaging not only has an environmental impact but directly affects the budget of the company, leads one to give packaging optimization for granted: this is not always true. For sectors such as the beverage industry, where packaging represents the highest environmental impact (and a significant cost for producers), packaging reduction and, in particular, the minimization of the PET parison weight, covers strategic importance: any change in the packaging material and/or design, however, should not affect the CO₂ retention performance, which is the key parameter determining the shelf life of the product [25,92,93]

7. Adjust the packaging value chain to enable a more sustainable food system that enables less food waste as well as more sustainable packaging.

8. Specific price determining factors govern decision making on what packaged food to purchase for low-income populations and creating affordable as well as sustainable packaging is essential.

9. Adopting a consistent definition for sustainability across the industry is overdue.

9.2. Strategies to Communicate Sustainability to Consumers

1. Innovate with package design as an avenue worthy of innovation in communicating sustainability to consumers. This is because cue utilization has demonstrated that graphics, materials, verbal text, and colors do not communicate well individually to consumers on sustainability.

2. Define sustainable criteria, much like clean label criteria, that can be used to communicate aspects of sustainability that resonate with consumers. For example, checklists such as recyclable, made of recycled content, reduced package volume, etc. may resonate with consumers.

3. Realize that companies with socially responsible corporate values will be more credible to target consumers only if environmental claims have substance and connect meaningfully with consumers.

4. Use comprehensive LCAs that encompass an assessment of the packaging and its ability to decrease food waste, which is essential for a more sustainable food system.

5. Pursue category-wide initiatives to switch to a lower volume container and a more sustainable design or material that are successful and provide leadership that consumers need in sustainability

6. Link sustainability data with smartphone technology that informs consumers on proper packaging disposal (recycling, composting, etc.) in the area in which the product is used and lets consumers track their sustainability efforts as this would provide much-needed direction and connection for consumers.

7. Incorporate consumer food waste and recycling behaviors in packaging LCA studies and communicate the social and economic impacts.

8. Learn about the most effective packaging design cues communicating eco-friendliness in a product category (packaging value is highly category specific).
9. Promote behaviors generating positive spillover effects and avoid those causing negative spillover.
10. Promote actions that support consumers' self-perceptions and make them look more socially desirable.
11. Design universal (not culture-specific) labels or markings for identifying reusable and recyclable packaging.
12. Employ a list of uniform criteria for the sustainability assessment of nominees for awarding novel packaging ideas and models. For example, when non-favorable ideas such as ocean-degradable plastic that contaminate the ocean upon degradation receive awards, packaging professionals often need to explain to internal leadership why these polymers are not a viable option or sustainable for a certain product within their company.
13. Focus on awarding models that can have larger scale shifting impacts such as recycle-ready packaging that allows for ease of label removal at recyclers and the employment of viable compatibilizers.

9.3. Research Needs

1. Understand that consumer willingness to pay (WTP) for sustainability features are not offset when consumers are informed that sustainable packaging enables less food waste and less money lost on spoiled food. Research on how to reverse consumer willingness to lose money by wasting food is essential to achieve a more sustainable food supply.
2. Gain a better understanding of consumer dynamics such as recycling and environmentally conscious purchase decisions.
3. Learn about the most common misconceptions about packaging for educating your customers and meeting shared value goals.
4. Increase the knowledge of pro- and neutral-environmental consumers for sustainability behaviors regarding packaging. Research on how male purchases toward more sustainable packaging can be increased is needed since the male population is less likely to purchase sustainable packaging.
5. Define consumer attitudes as a function of low, lower-middle, and upper-middle populations to allow sustainable packaging that resonates with all consumers.
6. Internalize consumption of food and packaging with consumers. For a truly more sustainable food supply, food waste and sustainable packaging are best assessed in unison. The environmental costs of consuming food and its packaging are not internalized in the costs of packaged food. For example, meat consumes more resources and generates more greenhouse gases per nutrient than many pulses. However, the environmental impact is not experienced by consumers who consume foods grown and manufactured far away from where they are consumed. For example, a Chinese consumer consuming canned beef grown in Brazil does not experience the environmental impact of cattle feedlots in Brazil. Likewise, they do not experience the impact of bauxite mining in Brazil. Problematically, the environmental costs of cattle raising and bauxite mining are not internalized in the costs of beef and aluminum for food and canning respectively. Internalizing these environmental costs within the packaged product is important to guide decision making and enable consumers to make informed decisions.
7. Assess the motives for recycling specific material types.

Table 2. List of recent publications on the assessment of consumer aspects and sustainable behaviors related to packaging.

Title	Assessment	Year	Reference
<i>Material, Color, Form, and Other Design Elements</i>			
Communicating packaging eco-friendliness: An exploration of consumers' perceptions of eco-designed packaging	Graphical/iconic, structural, and informational cues on perceived benefits and sacrifices by consumers	2015	[3]
Design and Communication of Ecological Content on Sustainable Packaging in Young Consumers' Opinions	Effects of packaging design and on-label statements on purchase intentions of Polish and French students	2016	[4]
The Effects of Single-Serve Packaging on Consumption Closure and Judgments of Product Efficacy	Portioned packaging effects on perceived product efficacy and adequacy	2016	[84]
Consumer response to packaging design: The role of packaging materials and graphics in sustainability perceptions and product evaluations	Perceptions and attitudes related to packaging material and graphics	2017	[10]
Color harmonies in packaging	Labels and product display were assessed simultaneously with color harmonies on consumer preference	2017	[94]
How Do Packaging Material, Colour, and Environmental Claim Influence Package, Brand and Product Evaluations?	Environmental claim in combination with material, color on the product eco-friendliness and social responsibility of the brands	2017	[95]
Implicit communication of food product healthfulness through package design: A content analysis	Implicit packaging design elements (E.g. color, image, material, and shape) and communication of healthfulness to consumers in Denmark and the United States	2018	[96]
Consumer attitudes towards biobased packaging—A cross-cultural comparative study	Evaluation of the environmentally friendly attributes of packaging in Germany, the US, and France	2018	[60]
Understand sustainable packaging design in practice	Interviews with employees from companies who are willing to improve the sustainability of their packaging to explore the practical aspects of sustainable packaging design	2018	[97]
Effects of sustainable design strategies on consumer preferences for redesigned packaging	Impacts of redesigned packaging with circular design principles on purchase intentions	2018	[98]
The impact of sustainable packaging in the purchase intent of consumers	Packaging attributes such as color, material, recycling status, and purchase intentions of consumers	2019	[99]
Consumer response to sustainable packaging design	A thesis	2019	[100]
Symbolic Meaning in Beverage Packaging and Consumer Response	Material, visual elements, and material design for consumer decision-making	2019	[101]
Consumers' response to environmentally-friendly food packaging—A systematic review	A systematic review	2020	[102]

Table 2. Cont.

Title	Assessment	Year	Reference
A consumer definition of eco-friendly packaging	Effect of material (Recyclability, biodegradability etc.), price, graphics and manufacturing technology on consumer purchase intentions and perceptions	2020	[103]
<i>Labels and on-Label Statements</i>			
Sustainability labels on coffee: Consumer preferences, willingness-to-pay and visual attention to attributes	Willingness to pay, fixation count and time on sustainability labels (USDA Organic, Carbon footprint etc.) presented on coffee packaging	2015	[104]
Isolated Environmental Cues and Product Efficacy Penalties: The Color Green and Eco-labels	Effect of color green and eco-labels on consumer perceptions of product efficacy and following purchase intentions	2017	[34]
A framework to evaluate eco- and social-labels for designing a sustainability consumption label to measure strong sustainability impact of firms/products	A proposed framework including a sustainability index and development of an eco-label from the index to improve the understanding a company/product's sustainability	2018	[105]
Sustainable consumption and third-party certification labels: Consumers' perceptions and reactions	Third-party sustainability labels and their impact on perceived risks and purchase intentions	2018	[64]
Designing for Packaging Sustainability. The Effects of Appearance and a Better Eco-Label on Consumers' Evaluations and Choice	Appearance and eco-label on consumer perceptions and preferences	2019	[106]
<i>Consumer and Product-Related Factors</i>			
Examining green consumerism motivational drivers: does premium price and demographics matter to green purchasing?	Effect of consumer demographics and premium price of sustainable products on purchase patterns	2016	[56]
Don't be satisfied, identify! Strengthening positive spillover by connecting pro-environmental behaviors to an "environmentalist" label	Consumer spillover effects related to self-identification of environmentally friendliness	2016	[50]
Consumer Perceptions of Food Packaging: Contributing to or Counteracting Environmentally Sustainable Development?	Effect of perceptions and knowledge on environmental aspects packaging on sustainable development in Sweden	2016	[28]
Environmental sustainability of liquid food packaging: Is there a gap between Danish consumers' perception and learnings from life cycle assessment?	Difference between young Danish consumers' sustainability perception of liquid food packaging and LCA	2019	[107]
Does Packaging Influence Purchase Decisions of Food Products? A Study of Young Consumers of India	Packaging costs, convenience, and utility effects on purchase decision	2019	[62]
Malaysian consumers' preference for green packaging	Application of behavior theories to determine the key factors affecting consumer preference	2019	[63]
What affect consumers' willingness to pay for green packaging? Evidence from China	Principal factor analysis method to determine the factors affecting WTP for eco-friendly packaging		

Table 2. Cont.

Title	Assessment	Year	Reference
Factors Influencing Consumers' Decision to Purchase Food in Environmentally Friendly Packaging: What Do We Know and Where Do We Go from Here?	A systematic review of literature investigating the factors effecting purchase decision of consumers including consumer- and packaging-related factors	2019	[108]
<i>Retail, Consumption and Post-consumption Behaviors and Food Waste</i>			
The influence of packaging attributes on recycling and food waste behaviour—An environmental comparison of two packaging alternatives	The impact of a lightweight tube and tray for minced meat on recycling and food waste behaviors	2016	[23]
Packaging and Food Waste Behavior	Different packaging characteristics to food wastage by consumers	2017	[109]
The Next Generation of Sustainable Food Packaging to Preserve Our Environment in a Circular Economy Context	A comprehensive review on sustainable food systems and food waste as it relates to packaging	2018	[11]
Customer Purchasing Behavior Analysis as Alternatives for Supporting In-Store Green Marketing Decision-Making	Analysis of consumer decision-making to promote sustainable products in the retail store	2017	[110]
Consumer responses to elimination of overpackaging on private label products	Consumer perception of products and purchase intention for private label products with eliminated overpackaging	2015	[76]
The Influence of Excessive Product Packaging on Green Brand Attachment: The Mediation Roles of Green Brand Attitude and Green Brand Image	Overpackaging effects on “green” brand image and attitudes of consumers	2017	[75]
Why do consumers recycle? A holistic perspective encompassing moral considerations, affective responses, and self-interest motives.	Goal framing theory on assessing and predicting the recycling behavior of consumers	2017	[111]
Solution for sustainable development: provisions limiting the consumption of disposable plastic carrier bags in Poland	Impact of recycling fee on the impact of the consumption of plastic bags	2018	[112]
Realizing the End-of-life Considerations in the Design of Food Packaging	Impact of post-consumption considerations on design process and providing design strategies	2018	[113]
The Influence of Packaging Design Features on Consumers' Purchasing & Recycling Behaviour	Effect of graphics, information, and form on consumer purchase and recycling behavior	2018	[114]
The Role of Food Packaging Design in Consumer Recycling Behavior—A Literature Review	A review	2019	[115]

Table 2. Cont.

Title	Assessment	Year	Reference
Effects of Packaging and Food Waste Prevention by Consumers on the Environmental Impact of Production and Consumption of Bread in Norway	Effects of packaging and food waste reduction on environmental impact	2018	[116]
Considering ecologically sustainable packaging during decision-making while buying food products	Environmentally friendly packaging purchase behaviors while shopping	2019	[117]
The paradox between the environmental appeal of bio-based plastic packaging for consumers and their disposal behaviour	Effect of compostable and recyclable packaging on disposal rates and consumer appeal	2020	[118]

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