Paper Meets Plastic: The Perceived Environmental Friendliness of Product Packaging

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Packaging waste makes up more than 10% of the landfilled waste in the United States. While consumers often want to make environmentally friendly product choices, we find that their perceptions of the environmental friendliness of product packaging may systematically deviate from its objective environmental friendliness. Eight studies ($N = 4{,}103$) document the perceived environmental friendliness (PEF) bias whereby consumers judge plastic packaging with additional paper to be more environmentally friendly than identical plastic packaging without the paper. The PEF bias is driven by consumers' "paper = good, plastic = bad" beliefs and by proportional reasoning, wherein packaging with a greater paper-to-plastic proportion is judged as more environmentally friendly. We further show that the PEF bias impacts consumers' willingness to pay and product choice. Importantly, this bias can be mitigated by a "minimal packaging sticker" intervention, which increases the environmental friendliness perceptions of plastic-only packaging, rendering plastic-packaged products to be preferable to their plastic-plus-paper-packaged counterparts. This research contributes to the packaging literature in marketing and to research on sustainability while offering practical implications for managers and public policy officials.

Keywords: sustainability, packaging, cognitive biases, heuristics

Waste from packaging poses a serious environmental problem. The US Environmental Protection Agency reports that there were more than 80 million tons of packaging produced in 2018, with two-thirds of this packaging made of plastic or paper. Once the packaging is no longer in use, some of it is recycled, but much of it ends up in landfills. In 2018 alone, landfilled plastic and paper packaging waste amounted to 10.09 and 6.44 million tons, respectively, accounting for 11% of the total landfilled waste in the United States (United States Environmental Protection Agency 2020).

Despite the potential environmental and financial benefits of reducing excessive packaging (Deutsch 2007; Elgaaïed-Gambier 2016), many products remain

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Editor: Markus Giesler

Associate Editor: Oleg Urminsky

Advance Access publication January 28, 2023

 • Vol. 50 • 2023
https://doi.org/10.1093/jcr/ucad008

overpackaged, with layers of superfluous packaging added to the more necessary ones. Examples of overpackaged products can be found across product categories and geographic markets (table 1). For example, Nivea sells body lotion packaged in plastic and cardboard boxes, even though a similar product from the same brand is available in plastic tubes only. By the same token, Sensodyne toothpaste is commonly sold in plastic tubes with additional paper packaging, while the same brand already sells toothpaste without paper boxes. We present a more extensive list of examples of overpackaging in web appendix A.

Besides specific brands engaging in overpackaging, there are entire product categories where addition of layers of superfluous packaging is common. Breakfast cereal is often packaged first in plastic bags and then in cardboard boxes; plastic yogurt multipacks are covered with additional cardboard sleeves; and skincare products are placed within paper boxes. In this article, we examine consumer responses to product overpackaging, focusing on consumer perceptions of plastic packaging versus plastic packaging with additional paper packaging (i.e., plastic-plus-paper packaging).

We argue and show empirically that consumers tend to perceive overpackaged products, wrapped in plastic plus paper, as having more environmentally friendly packaging than their plastic-only-wrapped counterparts. We refer to this effect as the perceived environmental friendliness (PEF) bias. We demonstrate that the PEF bias is driven by consumers' "paper = good, plastic = bad" beliefs and by proportional reasoning, wherein packaging with a greater paper-to-plastic proportion is judged as more environmentally friendly. As a result of this evaluation process, holding the amount of plastic in product packaging fixed, adding more paper to it leads to higher perceived environmental friendliness, even though objective environmental friendliness decreases. Importantly, the PEF bias has downstream consequences for consumers' willingness to pay and product choice, such that consumers are willing to pay more for products packaged with additional layers of paper and are more likely to choose them compared to their

TABLE 1

EXAMPLES OF PLASTIC-PLUS-PAPER- AND PLASTIC-PACKAGED PRODUCTS

NOTES.—Packaging examples from different grocery stores and pharmacies. Each row features four different pairs of products where the left product is packaged in plastic plus paper and the right product is packaged in plastic only.

plastic-packaged alternatives. Finally, we introduce an actionable "minimal packaging sticker" intervention, which increases the environmental friendliness perceptions of plastic-only packaging and makes consumers more likely to choose plastic-packaged products over their plastic-plus-paper overpackaged counterparts.

We note that our findings can be generalized beyond the context of overpackaging: driven by "paper = good, plastic = bad" beliefs and proportional reasoning, people will likely perceive mixed packaging, where paper partially replaces plastic (e.g., paper packaging with a small plastic window), to be more environmentally friendly than plastic-only packaging. However, while mixed packaging can increase the objective environmental friendliness of packaging overall, overpackaging, where paper is added to fixed amounts of plastic, does not. As such, it is particularly important to examine consumers' responses to overpackaged goods to understand whether and when their perceptions of packaging environmental friendliness will diverge from objective reality.

Our research contributes to the packaging literature in marketing. Several studies show that packaging design characteristics, such as packaging size (Argo and White 2012; Coelho do Vale, Pieters, and Zeelenberg 2008), shape (Chandon and Ordabayeva 2009), color (Mai, Symmank, and Seeberg-Elverfeldt 2016), and front-of-pack labeling (Dubois et al. 2021), affect consumers' purchase decisions and consumption. We add to the above line of work by showing how packaging composition—plastic only versus plastic plus paper—affects consumers' evaluations of product packaging and shapes their willingness to pay and choice.

Moreover, our work adds to the emerging literature on consumer behavior and sustainability. Research suggests that perceived environmental friendliness of products and product packaging influences consumer judgments and choice. It can increase food quality perceptions (Magnier, Schoormans, and Mugge 2016), improve overall brand attitudes (Olsen, Slotegraaf, and Chandukala 2014), and increase product usage rates (Lin and Chang 2012). At the same time, perceived environmental friendliness can reduce preference for products with strength-related attributes (Luchs et al. 2010) and reduce perceived product efficacy (Lin and Chang 2012). Critically, much less is known about how consumers come to perceive a product or product packaging as environmentally friendly in the first place (for exceptions, see Gershoff and Frels 2015; Reid, Gonzalez, and Papalambros 2010). We add to this work by outlining the psychological underpinnings of environmental friendliness judgments of product packaging.

This research also has important practical implications. A few companies, such as premium skincare brand Kiehl's, Procter & Gamble, and Nestle, are taking action to eliminate unnecessary packaging and reduce packaging waste. For instance, Kiehl's avoids using unnecessary paper cartons for their products. Similarly, Procter & Gamble eliminated cardboard box packaging for their Crest toothpaste; and Nestle Waters, North America, switched to narrower paper labels on their bottles, an initiative saving the company over 20 million pounds of paper over a 5-year period (Deutsch 2007). However, our findings across multiple product categories suggest that when companies eliminate paper packaging in plastic-packaged products, they may be penalized by consumers who will perceive plastic-only packaging as less, and not more, environmentally friendly. Critically, we find that explicitly stating that a given product uses minimal packaging via, for example, on-package stickers, attenuates the perceived environmental friendliness bias in packaging evaluations and choice. As such, our work underscores the importance of combining companies' packaging waste reduction initiatives with marketing communications that draw consumer attention to the amount of packaging used in minimally packaged products.

Finally, our work has implications for policymakers and non-governmental organizations (NGOs). Elimination of superfluous packaging will reduce the amount of greenhouse gas emissions from both the production and disposal of product packaging. One of the proposed ways to reduce environmental waste is through a pre-cycling strategy, wherein consumers consciously reduce waste by not buying overpackaged products (Elgaaïed-Gambier 2016). Our work suggests that shifting responsibility toward consumers may not be a very successful strategy of packaging waste reduction, since consumers' perception of the environmental friendliness of packaging may not align with its objective environmental friendliness. Asking managers to eliminate superfluous packaging may not work either. As noted earlier, managers may be disincentivized to eliminate unnecessary paper packaging, because the addition of paper packaging can boost their customers' environmental friendliness evaluations, willingness to pay, and choice. Our intervention study, however, suggests that a "minimal packaging" sticker can correct consumer perceptions of environmental friendliness of product packaging and boost demand. Thus, governments and NGOs may consider introducing minimal packaging certifications and on-package labels that would motivate consumers to buy and, consequently, incentivize companies to offer minimally packaged products.

In the next sections, we build our predictions and report eight experiments testing our theorizing. We conclude by discussing the theoretical and practical implications of this research.

CONCEPTUAL FRAMEWORK

We propose that consumers will perceive the objectively less environmentally friendly plastic-plus-paper packaging

as more environmentally friendly than plastic-only packaging. Our theorizing relies on three core propositions. First, we propose that objective and subjective evaluations of the environmental friendliness of product packaging may diverge. Second, we propose that in their subjective evaluations of the environmental friendliness of product packaging, consumers will rely on a "paper = good, plastic = bad" belief. Finally, we propose that consumers will use the "good paper-to-bad plastic" proportion, as opposed to the total amount of product packaging, to judge packaging environmental friendliness. Next, we discuss the research pertinent to these three propositions and build our specific predictions.

Objective and Perceived Environmental Friendliness

Marketing and social psychology research outlines several ways to make consumer behaviors more sustainable—from making environmentally friendly product choices more socially desirable, to rewarding these choices with monetary incentives, to discouraging environmentally unfriendly ones by anticipated guilt (White, Habib, and Hardisty 2019). Importantly, the research also indicates that often consumers cannot objectively assess the environmental footprint of different products, meaning that their understanding of what constitutes a sustainable or environmentally friendly product choice may be limited or incorrect. For instance, Gershoff and Frels (2015) demonstrate that products with identical environmental benefits are judged differently, depending on whether the green benefits stem from more versus less central product attributes. As such, holding the overall amount of recycled materials in a product constant, consumers are more likely to view a waffle maker (that can also make paninis) as more environmentally friendly when its waffle plates are made of 90% recycled aluminum, compared to when its panini plates are. In another study attesting to the subjective nature of consumers' environmental friendliness perceptions, Reid et al. (2010) show that product designs that have fewer abrupt line changes are perceived as inspired by nature and, consequently, are erroneously seen as more environmentally friendly.

While this prior research focuses on the products' environmental friendliness, it has bearing on the products' packaging as well. Similar to judgments of product environmental friendliness, objective evaluations of packaging environmental friendliness require that consumers gather and integrate large amounts of information about the relative environmental footprint of different packaging materials. To illustrate, the Environment Agency of England and Whales conducted a life-cycle assessment of different supermarket carrier bags. The assessment across nine environmental impact categories, such as the global warming potential and contribution to depletion of environmental resources, revealed that conventional plastic bags had the lowest impact in eight of the nine studied categories and that this impact largely depended on the number of times a bag was reused (Edwards and Fry 2011). Given the complexity of objective assessment of environmental friendliness, we propose that consumers will rely on simplified decision-making and use heuristics in their judgments of environmental friendliness of packaging. These heuristics could be based on consumers' beliefs about packaging materials, which we discuss next.

Paper and Plastic Packaging Beliefs

We propose that consumers' personal experience and beliefs, as well as exposure to external cues, will facilitate a belief that paper is relatively good for the environment, while plastic is relatively bad, what we refer to as "paper = good, plastic = bad" belief.

Personal Experience and Beliefs. First, people form the "paper = good, plastic = bad" belief through repeated sensory experience with paper and plastic. Blind-test data suggest that people find the touch of paper to be more pleasant than that of plastic (Klöcker et al. 2012). Similar to the formation of implicit brand attitudes based on past preferences, repeated sensory experiences may result in more positive associations for paper and more negative associations for plastic (Maison, Greenwald, and Bruin 2004). Second, "paper = good, plastic = bad" belief may be formed based on an intuition that paper is more natural and derived from trees, while plastic is more artificial. Driven by the "natural is better" heuristic (Hagen 2021; Meier, Dillard, and Lappas 2019), consumers can come to perceive "natural" paper as good and "unnatural" plastic as bad.

At the same time, plastic packaging, a material causing less environmental harm at the production stage and arguably more harm during disposal (Edwards and Fry 2011), may be seen as substantially worse for the environment because of people's innate tendency to perceive later-timed events as more consequential. For example, a basketball player scoring a 2-point basket at the 40th minute of a 40 minute game is seen as contributing more to the outcome of the game compared to a player scoring a basket at the 7th minute (Ziano and Pandelaere 2022). Similarly, products causing environmental harm first and benefits later (e.g., electric car made in a conventional way, but producing no emissions while driven) are seen as having more positive environmental impact than products producing environmental benefits first and causing harm later (e.g., gasoline car made with recycled materials that emits gas while driven; Hur et al. 2021).

Further attesting to the idea that plastic may be seen as more environmentally harmful than paper because of its environmental footprint during disposal, in-depth interview

data from a panel of Dutch consumers indicate that consumers largely ignore production, transportation, and storage considerations when forming their environmental friendliness evaluations and mainly focus on the post-consumption treatment of packaging waste. Consequently, they come to perceive non-returnable plastic as more environmentally harmful compared to non-returnable cardboard but perceive returnable plastic as less harmful (van Dam 1996).

External Cues. In addition to consumers' sensory experiences and beliefs, several external sources facilitate the "paper = good, plastic = bad" belief. First, the belief is fostered by the availability of paper bags and unavailability of plastic bags in grocery stores purporting to be more environmentally friendly, such as Whole Foods and Trader Joe's (Dapcevich 2019; Martin 2008). By the same token, the belief is strengthened by paper packaging of foods positioned in terms of their "all natural ingredients." To illustrate, several small organic coffee brands (e.g., Real Good Coffee Co., Fresh Roasted Coffee) and organic chocolate brands (e.g., Dagoba, Green, and Black's) use paper and the distinct color of cardboard boxes for outer packaging of their products. Similarly, content analysis of product packaging across four product categories in Austria, Denmark, Sweden, and Switzerland indicates that products positioned as organic are more likely to feature paper and less likely to feature plastic in their packaging (Chrysochou and Festila 2019).

Second, media present consumers with messages consistent with the "paper = good, plastic = bad" belief. Plastic waste has received much negative media attention in recent years, with coverage of plastic pollution and plastic waste appearing in outlets such as *The Guardian*, *The New York Times*, and *The Washington Post*. Consumers receive news about national and municipal governments instituting plastic bag bans (Nielsen, Holmberg, and Stripple 2019) and plastic straw bans (Smith 2020), while allowing single-use paper bags and straws. People are also presented with visceral images of animals dying from plastic waste in documentaries like *Planet Blue II* (Dunn, Mills, and Veríssimo 2020).

In sum, we propose that repeated sensory experiences, naturalness/unnaturalness beliefs, combined with unequal weighing of environmental impact from production versus disposal, and interactions with companies and mass media foster the "paper = good, plastic = bad" belief in consumers' minds.

Packaging Amount versus Packaging Proportions

Even though consumers often lack the information needed to accurately judge packaging environmental friendliness (Gifford 2011), in most cases, they can easily see the amount of product packaging, by, for example, examining the size of the packaging; or the number of layers used to pack a given item. Thus, packaging amount may be a likely driver of environmental friendliness perceptions, with packaging using additional layers or larger amounts of materials being deemed less environmentally friendly. Following this logic, toothpaste that comes in a plastic tube plus a paper box ought to be considered worse for the environment than toothpaste that comes in a plastic tube only.

Running counter to the above "less is better" logic, the general evaluability theory suggests that people may not rely on packaging amount in their evaluations because they will have difficulty assessing whether a given amount of packaging is large or small (Hsee and Zhang 2010). For example, Hsee (1998) reports that people do not rely on the absolute size of a product in their willingness to pay judgments, because absolute size is difficult to evaluate. As a result, people become willing to pay more for a dinnerware set with 24 intact pieces compared to a set with 31 intact and 9 broken pieces and for a cup overfilled with 7 oz of ice cream compared to a cup partially filled with 8 oz of ice cream.

Given that consumers may be unable to evaluate the absolute amount of product packaging when evaluating its environmental friendliness, we propose that they will rely on the paper-to-plastic proportion, a salient and easily evaluable cue, when assessing packaging environmental friendliness. In line with this logic, extant research suggests that proportional reasoning guides consumer judgments in a range of domains, from sensory perception (Garner 1953; Krishna and Hagen 2019), to gamble assessments (De Langhe and Puntoni 2015), to product evaluations (Hsee 1998).

In sum, we argue that, guided by the "paper = good, plastic = bad" belief, people should judge packaging that consists of 100% plastic as low in perceived environmental friendliness. Critically, once a layer of "good" paper is added to a layer of "bad" plastic, the proportion of paper to plastic will increase, leading consumers to judge an objectively larger amount of packaging to be more environmentally friendly compared to a smaller amount of packaging consisting of plastic alone. We refer to this effect as the PEF bias in packaging evaluations.

OVERVIEW OF STUDIES

We report eight studies supporting our theorizing ($N = 4{,}103$; see table 2 for an overview). Studies 1a and 1b provide evidence of the PEF bias. They show that adding paper to a layer of plastic increases the perceived environmental friendliness of product packaging. Studies 2a and 2b test the underlying process. Study 2a shows that the effect of adding paper to plastic is stronger when the proportion of paper in product packaging increases. Study 2b

TABLE 2

OVERVIEW OF STUDIES

A: Study 1a: product packaging and PEF ($N = 205$, $M_{age} = 21.04$, 64% female, Lab)				
	Plastic condition			Plastic + paper condition
PEF score ($\alpha = 0.89$)	1.87 (0.90)[a]			2.67 (1.30)
Study design	Two-cell between-subjects design; participants rated a granola bar packaging on the four-item PEF scale			
Main finding	Plastic + paper packaging is perceived as more environmentally friendly than plastic-only packaging.			
B: Study 1b: visible versus hidden plastic ($N = 301$, $M_{age} = 44.60$, 42% female, MTurk)				
	Plastic condition	Visible plastic + paper condition		Hidden plastic + paper condition
PEF score ($\alpha = 0.95$)	2.23 (1.36)	3.36 (1.58)		2.69 (1.40)
Study design	Three-cell between-subjects design; participants rated a chocolate bar packaging on the PEF scale.			
Main finding	Plastic + paper packaging is perceived as more environmentally friendly than plastic-only packaging even when plastic is initially hidden under paper and revealed later as a surprise.			
C: Study 2a: PEF bias and proportion of paper ($N = 801$, $M_{age} = 41.37$, 51% female, MTurk)				
	Plastic condition	Plastic + paper 1:0.5 proportion condition	Plastic + paper 1:1 proportion condition	Plastic + paper 1:2 proportion condition
PEF score ($\alpha = 0.93$)	2.16 (1.14)	2.91 (1.20)	3.06 (1.34)	3.34 (1.48)
Study design	Four-cell between-subjects design; participants rated tomato packaging on the PEF scale.			
Main finding	PEF bias is stronger when the paper-to-plastic proportion in packaging is large.			
D: Study 2b: PEF bias and paper–plastic beliefs ($N = 602$, $M_{age} = 35.13$, 54% female, ProlificCo)				
		Plastic condition		Plastic + paper condition
PEF score ($\alpha = 0.95$)		3.28 (1.44)		4.37 (1.49)
PEF score: participants with strong "paper = good, plastic = bad" beliefs (+1 SD)		3.01		4.42
PEF score: participants with weak "paper = good, plastic = bad" beliefs (−1 SD)		3.51		4.30
Study design	Packaging type was manipulated between subjects, "paper = good, plastic = bad" beliefs were measured on multi-item scales, and participants rated honeycomb packaging on the PEF scale.			
Main finding	PEF bias is stronger among people with stronger "paper = good, plastic = bad" beliefs (packaging type and beliefs interaction: $F(1, 598) = 6.73$, $p = .010$).			
E: Study 3: implications for willingness to pay ($N = 802$, $M_{age} = 41.16$, 54% female, ProlificCo)				
	Plastic condition			Plastic + paper condition
PEF score ($\alpha = 0.95$)	2.77 (1.47)			3.81 (1.42)
WTP	\$0.94 (0.48)			\$1.09 (0.53)
Indirect effect of packaging type on WTP via PEF: $b = 0.05$, SE = 0.01, 95% CI: (0.02; 0.08)				
Study design	Two-cell between-subjects design; participants reported WTP for a granola bar. Next, on a separate screen, they rated the granola packaging on the PEF scale.			
Main finding	Addition of paper to plastic in granola packaging increased WTP by 16% and increased packaging PEF scores. The effect of packaging type on WTP was partially driven by PEF.			
F: Study 4a: implications for choice ($N = 400$, $M_{age} = 34.80$, 67% female, ProlificCo)				
	Plastic condition			Plastic + paper condition
PEF score ($\alpha = 0.96$)	2.37 (1.40)			2.82 (1.57)
Packaging utility	−37.54 (67.07)			−15.38 (46.57)
Indirect effect of packaging type on packaging utility via PEF: $b = 3.81$, SE = 1.47, 95% CI: (1.42; 7.36)				
Study design	Two-cell between-subjects design. In a choice-based conjoint experiment, participants made 12 choices between chocolate bars that varied in their packaging, price, and flavor. For half the participants, the bars were either packaged in paper or in plastic. For the remaining participants, the bars were either packaged in paper or in plastic + paper. We estimated the utilities of plastic (plastic + paper) packaging from individual choices. At the end of the study, participants rated the plastic (plastic + paper) chocolate packaging on the PEF scale.			
Main finding	Addition of a layer of paper to plastic packaging made people more likely to select a chocolate over a chocolate packaged in paper. This effect was partially driven by PEF.			

(continued)

TABLE 2 (CONTINUED)

G: Study 4b: implications for choice of existing brands ($N = 402$, $M_{age} = 35.67$, 60% female, ProlificCo)		
	Plastic condition	Plastic + paper condition
PEF score ($\alpha = 0.96$)	2.72 (1.35)	4.44 (1.52)
Montperal brand utility	−47.33 (83.06)	−29.51 (86.45)
Indirect effect of packaging type on packaging utility via PEF: $b = 10.54$, SE = 5.71, 90% CI: (1.50; 20.33)		
Study design	Two-cell between-subjects design; participants made 12 choices among chips packs that varied in their brand, price, and weight. Half the participants chose between Lays, Tyrrells, and Montperal, all packaged in plastic. The remaining participants chose between the same brands, but the focal Montperal brand was packaged in plastic + paper. We estimated the utilities of the Montperal brand from individual choices. At the end of the study, participants rated the plastic (plastic + paper) Montperal packaging on the PEF scale.	
Main Finding	Addition of a layer of paper to plastic packaging made people more likely to select the Montperal brand over the other brands. This effect was partially driven by PEF.	
H: Study 5: on-package intervention ($N = 590$, $M_{age} = 19.93$, 51% female, Lab)		
	Plastic-control condition	Plastic-sticker condition
PEF score ($\alpha = 0.95$)	3.08 (1.47)	4.58 (1.47)
Plastic packaging utility	−10.98 (43.49)	35.05 (61.48)
Indirect effect of packaging type on packaging utility via PEF: $b = 9.89$, SE = 2.58, 95% CI: (5.14; 15.22)		
Study design	Two-cell between-subjects design; participants made 12 choices between granola bars that varied in their packaging, price, and flavor. Half the participants chose between bars packaged in plastic or in plastic + paper. The remaining participants chose between bars packaged in plastic with a "minimal packaging" sticker or in plastic + paper. We estimated the utilities of plastic packaging from individual choices. At the end of the study, participants rated the plastic (control vs. sticker) packaging on the PEF scale.	
Main finding	In the control condition, people were less likely to choose plastic-only packaged granola bars. By contrast, they were more likely to choose plastic-only packaged bars in the "minimal packaging" sticker intervention condition. This effect was partially driven by changes in the PEF of plastic packaging.	

[a]We report standard deviations of group means in parentheses.

demonstrates that the effect is stronger among people with stronger "paper = good, plastic = bad" beliefs. Studies 3–5 establish the downstream consequences of the PEF bias. Study 3 shows that consumers are willing to pay more for plastic-plus-paper-packaged products and this effect is driven by changes in PEF. Choice-based conjoint studies 4a and 4b demonstrate the implications of the PEF bias for consumer choice for hypothetical and real brands. Finally, choice-based conjoint study 5 shows that adding a "minimal packaging" sticker to plastic packaging attenuates the PEF bias and makes consumers more likely to choose plastic-packaged products over plastic-plus-paper (hereafter, plastic + paper)-packaged products. The study stimuli, anonymized data, and syntax files are available at https://researchbox.org/712.

STUDY 1A: PRODUCT PACKAGING AND PERCEIVED ENVIRONMENTAL FRIENDLINESS

Study 1a tests the effect of product packaging type—plastic versus plastic with an added layer of paper—in a laboratory setting using a real product—a granola bar.

Method

Two hundred five students at a public university completed the study ($M_{age} = 21.04$, 64% female). They were randomly assigned to one of two conditions in a two-cell (packaging type: plastic vs. plastic + paper) between-subjects design.

Participants, sitting in individual cubicles, saw a real product—a granola bar—packaged either in plastic or in plastic + paper (table 3). They were asked to rate the environmental friendliness of the granola bar packaging on a four-item 7-point scale (e.g., "This packaging is friendly to the environment"; 1 = strongly disagree; 7 = strongly agree; table 4) adapted from Gershoff and Frels (2015) and Haws, Winterich, and Naylor (2014). After rating the environmental friendliness of product packaging, participants completed the manipulation checks (see web appendix B for details). Finally, they reported their age and gender.

Results

The four PEF scale items ($\alpha = 0.89$) were averaged to compute a PEF score. A one-way ANOVA showed that perceived environmental friendliness was lower in the "plastic" condition than in the "plastic + paper" condition

TABLE 3

STUDY 1A: PACKAGING STIMULI

Plastic condition	Plastic+paper condition
	

TABLE 4

PERCEIVED ENVIRONMENTAL FRIENDLINESS (PEF) SCALE

Item 1	This packaging is friendly to the environment.
Item 2	The manufacturing and disposal of this packaging causes less harm to the environment.
Item 3	This packaging is relatively more eco-friendly than other packaging.
Item 4	This packaging deserves to be labeled "environmentally friendly."

($M_{plastic}$ = 1.87, SD = 0.90, vs. $M_{plastic+paper}$ = 2.67, SD = 1.30, $F(1, 203) = 25.69$, $p < .001$, $\eta_p^2 = 0.112$).

Discussion

Study 1a provides initial evidence of the PEF bias. It shows that adding a layer of paper to a layer of plastic increases the perceived environmental friendliness of product packaging.

STUDY 1B: VISIBLE VERSUS HIDDEN PLASTIC

In study 1a, participants evaluated the environmental friendliness of packaging with both plastic and paper packaging visible at the same time. However, consumers often encounter products whose plastic packaging is fully covered by outer paper packaging (web appendix A), meaning that plastic packaging could be uncovered as a surprise after consumers purchase the product. Study 1b tests whether the PEF bias will emerge in these settings.

Method

Three hundred one Amazon Mechanical Turk panelists (M_{age} = 44.60, 42% female) were randomly assigned to one of three conditions in a three-cell (packaging type: plastic vs. visible plastic + paper vs. hidden plastic + paper) between-subjects design.

On the first page, participants saw a picture of a packaged chocolate bar (top row in table 5). They then moved to a second page with the packaged chocolate image and the four-item PEF scale. Critically, participants in the "plastic" and "visible plastic + paper" conditions saw the same image on the first and second pages. Participants in the "hidden plastic + paper" condition saw the chocolate packaged in paper on the first page and then saw the chocolate packaged in plastic + paper on the second page. They also read that they "<found> the chocolate to be covered in a second layer made of translucent plastic wrap." Finally, participants reported their age and gender.

Results

The four PEF scale items ($\alpha = 0.95$) were averaged to compute a PEF score. A one-way ANOVA revealed a significant effect of packaging type on the PEF scores ($F(2, 298) = 15.35$, $p < .001$, $\eta_p^2 = 0.093$). Follow-up contrasts showed that the PEF was significantly lower in the "plastic" condition than in the "visible plastic + paper" condition ($M_{plastic}$ = 2.23, SD = 1.36, vs. $M_{visible\ plasitc+paper}$ = 3.36, SD = 1.58, $F(1, 298) = 30.34$, $p < .001$, $\eta_p^2 = 0.092$) and the "hidden plastic + paper" condition ($M_{plastic}$ = 2.23, SD = 1.36, vs. $M_{hidden\ plastic+paper}$ = 2.69, SD = 1.40, $F(1, 298) = 5.11$, $p = .025$, $\eta_p^2 = 0.017$). The PEF was also significantly lower in the "hidden plastic + paper" condition than in the "visible plastic + paper" condition ($M_{hidden\ plastic+paper}$ = 2.69, SD = 1.40, vs. $M_{visible\ plastic+paper}$ = 3.36, SD = 1.58, $F(1, 298) = 10.66$, $p = .001$, $\eta_p^2 = 0.035$).

Discussion

Study 1b suggests that the PEF bias emerges when plastic is visible upfront or hidden under paper and discovered later as a surprise, attesting to the generalizability of our results. The next two studies probe two theoretically relevant boundary conditions of the PEF bias, to test for its underlying mechanism.

STUDY 2A: PEF BIAS AND PROPORTION OF PAPER

Study 2a tests proportional reasoning as the underlying mechanism of the PEF bias. In this study, we manipulated the proportion of paper-to-plastic packaging by changing the size of paper packaging added to a layer of plastic, while keeping the size of plastic packaging constant. Per our theorizing, when the paper-to-plastic proportion in product packaging increases, the PEF should increase.

By manipulating the size of paper packaging, study 2a also aimed to probe an alternative averaging account of the PEF bias (Chernev and Gal 2010). If paper is perceived as more environmentally friendly than plastic, averaging of the perceived environmental friendliness of plastic and paper packaging layers would lead to lower PEF evaluations for plastic than for plastic + paper. Critically, when it

TABLE 5

STUDY 1B: PACKAGING STIMULI

	Plastic condition	Visible plastic+paper condition	Hidden plastic+paper condition
Screen 1			
Screen 2			

comes to adding layers of paper of varying sizes, the averaging and the proportional reasoning accounts' predictions diverge. A small-sized layer of paper should be perceived as more environmentally friendly than a large-sized layer of paper. Thus, per the averaging account, adding a small-sized layer of paper to plastic should lead to greater perceived environmental friendliness than adding a large-sized layer of paper to plastic. By contrast, per the proportional reasoning account, adding a small-sized layer of paper to plastic should lead to lower perceived environmental friendliness than adding a large-sized layer of paper, because in the former case the paper-to-plastic proportion will be smaller. Study 2a tests these competing predictions.

Method

Eight hundred two MTurk panelists completed this study. One participant was removed because of a duplicate IP, resulting in a final sample of 801 participants (M_{age} = 41.37, 51% female).[1]

Participants were randomly assigned to one of four conditions (packaging type: plastic vs. plastic + paper in three different proportions—1 plastic + ½ paper, 1 plastic + 1 paper, 1 plastic + 2 paper). While the amount of plastic packaging remained the same across conditions, the amount of paper increased, and consequently, so did the proportion of paper in product packaging (table 6). Packaging layers were presented on the same screen, one above the other. The presentation order of plastic and paper layers (paper on top vs. plastic on top) was counterbalanced.

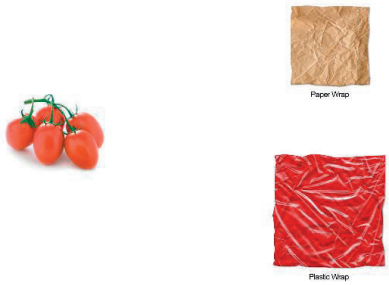
Participants were asked to imagine that they bought tomatoes at a farmers' market. They saw an image of tomatoes and an image of their packaging side by side. Presenting the tomatoes next to their packaging allowed us to make the amount of plastic and paper used in product packaging clear for the participants. In line with the paper-to-plastic proportion account, we expected that increasing the amount of added paper would increase the perceived environmental friendliness of product packaging.

Participants saw the tomato packaging and evaluated it on the four-item PEF scale. Next, participants completed a manipulation check (web appendix B) and reported their age and gender.

1 The results for this and the remaining studies with duplicate IP exclusions do not change if we include all completed surveys in the analysis. Web appendix C reports the result summaries with and without duplicate IP exclusions.

TABLE 6

STUDY 2A: PACKAGING STIMULI

Plastic condition	Plastic+paper in 1:0.5 proportion condition
	
Plastic+paper in 1:1 proportion condition	**Plastic+paper in 1:2 proportion condition**
	

Results

A one-way ANOVA on participants' PEF scores ($\alpha = 0.93$) revealed a significant main effect of packaging type on PEF ($F(3, 797) = 30.15$, $p < .001$, $\eta_p^2 = 0.102$). Simple contrasts showed that plastic-only packaging was perceived as less environmentally friendly compared to each of the other three plastic + paper packaging types (all ps $< .001$).

Importantly, consistent with the proportional reasoning account, the effect of adding paper to plastic was weaker when the paper-to-plastic proportion was small ($M_{\text{plastic}} = 2.16$, SD = 1.14, vs. $M_{1\ \text{plastic}+1/2\ \text{paper}} = 2.91$, SD = 1.20, $F(1, 797) = 32.62$, $p < .001$, $\eta_p^2 = 0.039$) than when it was medium ($M_{\text{plastic}} = 2.16$, SD = 1.14, vs. $M_{1\ \text{plastic}+1\ \text{paper}} = 3.06$, SD = 1.34, $F(1, 797) = 47.50$, $p < .001$, $\eta_p^2 = 0.056$), or large ($M_{\text{plastic}} = 2.16$, SD = 1.14, vs. $M_{1\ \text{plastic}+2\ \text{paper}} = 3.34$, SD = 1.48, $F(1, 797) = 83.58$, $p = .001$, $\eta_p^2 = 0.095$). A separate regression on the subsample of the three "plastic + paper" conditions with the paper-to-plastic proportion as a continuous independent variable confirmed that as the proportion of paper in product packaging increased, the PEF scores increased ($b = 0.28$, SE = 0.09, $t = 3.26$, $p = .001$).

Discussion

By demonstrating that the PEF bias is stronger (weaker) when the paper-to-plastic proportion in packaging is large (small), study 2a provides evidence for the proportional reasoning account of the PEF bias and against its averaging account.

One may argue that it is the absolute, not the relative amount of paper in product packaging, that drives the PEF bias. That is, the more paper there is in product packaging, the greater its perceived environmental friendliness. Data from studies 1a to 2a are indeed consistent with both the proportional and absolute amount of paper accounts of the PEF bias. To probe the absolute amount of paper account, we ran a follow-up study, where we compared the effect of adding paper to plastic and the effect of adding paper to paper (study A, web appendix D). Under the absolute amount of paper account, packaging comprised of one layer of paper should have lower PEF compared to packaging comprised of two layers of paper. By contrast, under the proportional reasoning account, one-layer and two-layer paper packaging should have similar PEF, since in both these cases, the packaging is composed of 100% paper. The results were consistent with the proportional

reasoning account and ran counter to the absolute amount of paper account: when a layer of paper was added to plastic packaging, consumers perceived the packaging as more environmentally friendly. The addition of a layer of paper to paper packaging had no effect on its perceived environmental friendliness.

STUDY 2B: PEF BIAS AND PAPER–PLASTIC BELIEFS

Study 2b tests the effect of consumers' beliefs about the environmental impact of paper and plastic on the PEF bias. Our theorizing implies that consumers hold "paper = good, plastic = bad" beliefs. As a result of these beliefs, consumers judge plastic + paper packaging as more environmentally friendly than plastic packaging. As such, we can expect that the PEF bias will be stronger among consumers with stronger "paper = good, plastic = bad" beliefs.

Method

Six hundred three ProlificCo panelists completed this study. One survey was removed because of a duplicate IP, resulting in a final sample of 602 participants (M_{age} = 35.13, 54% female).

Participants were randomly assigned to one of two conditions (packaging type: plastic vs. plastic + paper). In the main task, participants saw a honeycomb packaged in plastic or in plastic + paper (table 7) and rated the perceived environmental friendliness of the honeycomb packaging on the four-item PEF scale. Next, to capture participants' beliefs about plastic and paper, we asked them to indicate to what extent they believed that plastic and paper were bad for the environment on two separate three-item 7-point scales (web appendix E). The order of scales capturing the beliefs related to plastic and paper was counterbalanced. Finally, participants reported their age and gender.

Results

To test our predictions, we ran an ANCOVA with packaging type, participants' standardized explicit belief scores, and their two-way interaction as the independent variables and with the packaging PEF score ($\alpha = 0.95$) as the dependent variable. The explicit belief scores were computed as the difference between participants' beliefs about the environmental harm of plastic ($\alpha = 0.94$, $M = 6.10$, SD = 1.10) and their beliefs about the environmental harm of paper ($\alpha = 0.87$, $M = 3.54$, SD = 1.33). Higher explicit belief scores indicated that participants perceived greater differences between the environmental harm of plastic and paper, hereafter referred to as higher "paper = good, plastic = bad" belief scores.

The analysis revealed a main effect of packaging type ($F(1, 598) = 85.46$, $p < .001$, $\eta_p^2 = 0.125$) and a significant interaction between packaging type and explicit beliefs ($F(1, 598) = 6.73$, $p = .010$, $\eta_p^2 = 0.011$). The main effect of explicit beliefs was not significant ($F(1, 598) = 2.51$, $p = .114$, $\eta_p^2 = 0.004$).

Follow-up contrasts revealed that at the mean value of explicit beliefs, plastic packaging was perceived as less environmentally friendly than plastic + paper packaging ($M_{plastic} = 3.28$, SD = 1.44 vs. $M_{plastic+paper} = 4.37$, SD = 1.49, $F(1, 598) = 85.46$, $p < .001$, $\eta_p^2 = 0.125$), replicating previous results. Importantly, this effect was stronger among participants with higher "paper = good, plastic

TABLE 7

STUDY 2B: PACKAGING STIMULI

Plastic condition	Plastic+paper condition
	

= bad" belief scores (+1 SD; $M_{plastic}$ = 3.01 vs. $M_{plastic+paper}$ = 4.42, $F(1, 598) = 69.71$, $p < .001$, $\eta_p^2 = 0.104$) than among participants with lower "paper = good, plastic = bad" belief scores (−1 SD; $M_{plastic}$ = 3.51 vs. $M_{plastic+paper}$ = 4.30, $F(1, 598) = 22.16$, $p < .001$, $\eta_p^2 = 0.036$). Floodlight analysis (Spiller et al. 2013) revealed that the Johnson-Neyman point at which packaging type has a significant effect on PEF scores at $p = .05$ lies at $M_{beliefs} = -1.92$. In the sample, 99% of the explicit belief scores were above the Johnson-Neyman threshold of −1.92.

Discussion

The study tested the effect of explicit beliefs about plastic and paper on the PEF bias. The results suggest that the PEF bias is stronger among participants who believe that the difference between the environmental harm of plastic and paper is relatively large and weaker among those who believe that the difference between the environmental harm of plastic and paper is smaller.

Together, studies 1a–2b provide robust evidence of the PEF bias, attesting to its generalizability across different product categories and decision contexts. They also provide evidence of the underlying process of the PEF bias. The next four studies examine the downstream consequences of the PEF bias for consumer decision-making.

STUDY 3: IMPLICATIONS FOR WILLINGNESS TO PAY

Study 3 examines the implications of the PEF bias for consumers' willingness to pay.

Method

Eight hundred five ProlificCo panelists completed the study. Three surveys were removed due to duplicate IPs, resulting in a final sample of 802 participants (M_{age} = 41.16, 54% female).

Participants were randomly assigned to one of two conditions (packaging type: plastic vs. plastic + paper). In the main task, participants saw a granola bar packaged either in plastic or in plastic + paper (table 8) and indicated how much they would be willing to pay for the bar on an unmarked slider scale anchored on $0 on the left and on $4 on the right. Next, on a separate screen, participants rated the perceived environmental friendliness of the granola packaging on the four-item PEF scale. Finally, participants reported their age and gender.

Results

Willingness to Pay. A one-way ANOVA indicated that participants were willing to pay less for the plastic-packaged granola bar compared to the plastic + paper-packaged one ($M_{plastic}$ = $0.94, SD = 0.48, vs. $M_{plastic+paper}$ = $1.09, SD = 0.53, $F(1, 800) = 18.12$, $p < .001$, $\eta_p^2 = 0.022$).

Perceived Environmental Friendliness. Next, we analyzed participants' PEF scores ($\alpha = 0.95$) across the two packaging type conditions. Replicating prior results, a one-way ANOVA revealed that people perceived plastic packaging to be less environmentally friendly than plastic + paper packaging ($M_{plastic}$ = 2.77, SD = 1.47, vs. $M_{plastic+paper}$ = 3.81, SD = 1.42, $F(1, 800) = 103.84$, $p < .001$, $\eta_p^2 = 0.115$).

Mediation Analysis. A mediation analysis with 10,000 bootstrap samples revealed a significant indirect effect of packaging type on willingness to pay via PEF [$b = 0.05$, SE = 0.01, 95% CI: (0.02; 0.08); figure 1], suggesting that packaging type affected participants' willingness to pay for the granola bar by affecting the environmental friendliness perceptions of the bar's packaging.

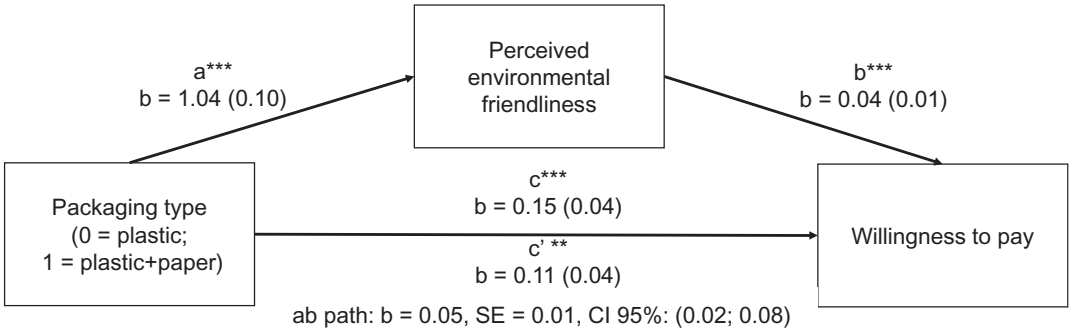
TABLE 8

STUDY 3: PACKAGING STIMULI

Plastic condition	Plastic+paper condition
	

FIGURE 1

STUDY 3: PERCEIVED ENVIRONMENTAL FRIENDLINESS OF PACKAGING MEDIATES THE EFFECT OF PACKAGING TYPE ON WILLINGNESS TO PAY



Coefficient standard errors are marked in parentheses.
* p < .05, ** p < .01, *** p < .001

Discussion

This study provides further evidence of the PEF bias in packaging evaluations and demonstrates its implications for consumers' willingness to pay. We observe that addition of a layer of paper to plastic packaging increased consumers' willingness to pay by 15 cents, or by 16%, a difference by no means trivial for the fast-moving consumer goods sector.

We also observe that the effect of packaging type on WTP was mediated by packaging environmental friendliness perceptions. However, packaging type may have affected willingness to pay via multiple mechanisms, for example, by changing the inferred product quality. Critically, if product quality is correlated with perceived environmental friendliness of packaging, study 3 would run the risk of overestimating the role of PEF in driving consumers' willingness to pay. As such, in our next study, we aimed to minimize the possibility that packaging type prompted additional inferences about product quality. Moreover, we aimed to explore whether PEF has implications for product choice, and not just willingness to pay.

STUDY 4A: IMPLICATIONS FOR CHOICE

While consumers may feel that they should pay more for products with additional packaging, they may be less likely to choose these products. Thus, study 4a tests the effect of packaging type on choice, using a choice-based conjoint experiment.

Method

Four hundred ProlificCo panelists completed the study ($M_{age} = 34.80$, 67% female). They were randomly assigned to one of two conditions (packaging type: plastic vs. plastic + paper).

At the beginning of the study, participants read that they would be making a series of choices between chocolate bars. The bars were described on three attributes—price ($3.00 vs. $3.50 vs. $4.00), packaging ("paper vs. plastic" vs. "paper vs. plastic + paper"), and flavor (dark chocolate vs. dark chocolate with strawberries). To rule out the possibility that our packaging manipulation led to additional interferences about product quality, participants were also explicitly informed that the evaluated chocolate bars varied only on price, packaging, and flavor.

Participants then made 12 choices between pairs of chocolate bars. The choice sets were created in Sawtooth software using the balanced overlap method (see table 9 for screenshots of sample choice tasks). In the "plastic" condition, the choice pairs included two types of packaging—paper (only) and plastic (only). In the "plastic + paper" condition, the choice pairs also included two types of packaging—paper (only) and plastic + paper. The inclusion of paper packaging in both conditions allowed us to compare participants' choice propensities for plastic packaging relative to plastic + paper packaging in a between-subjects setting.

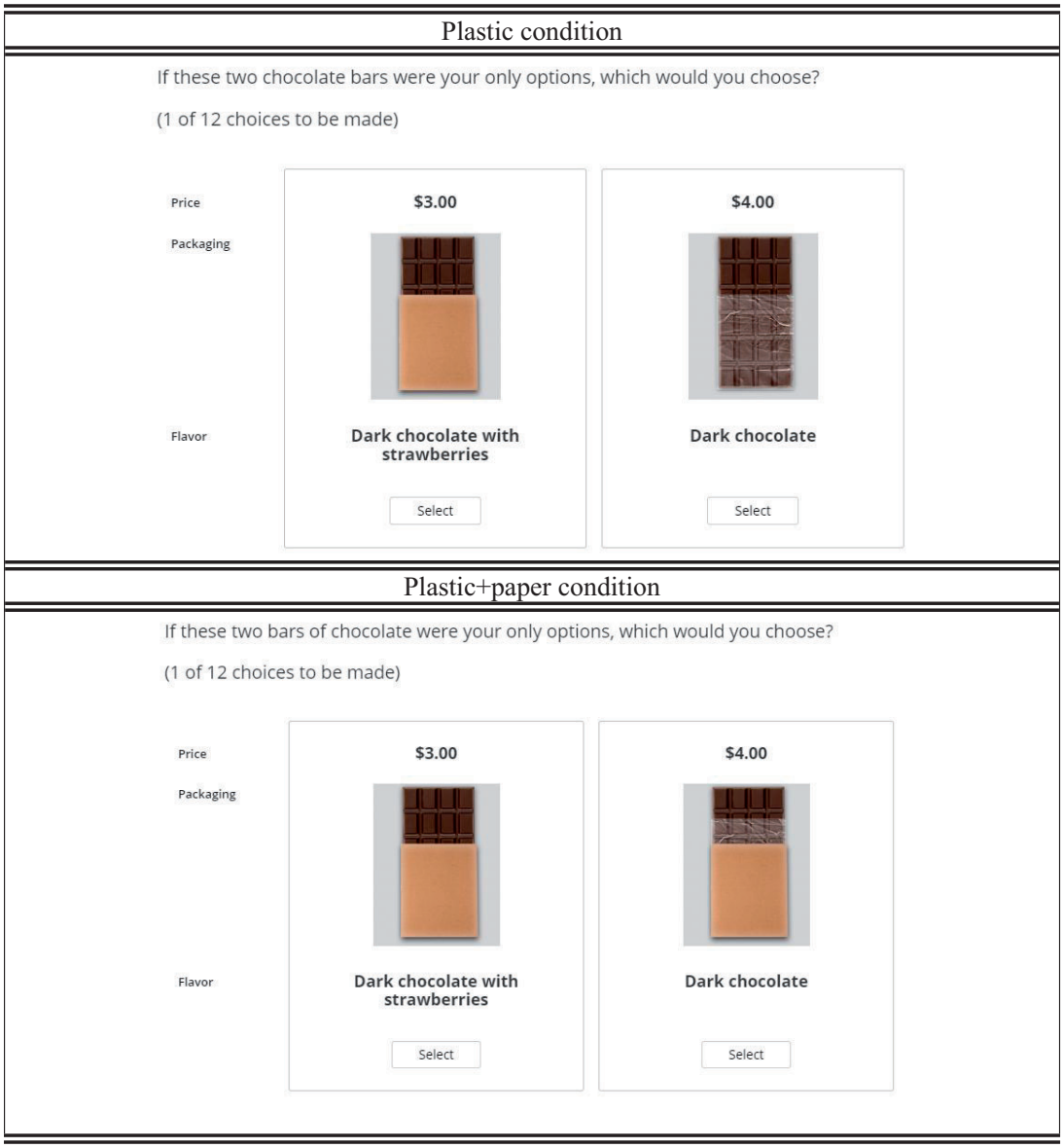
After making 12 choices between pairs of chocolate bars, participants in the "plastic" ("plastic + paper") condition saw a chocolate bar packaged in plastic (plastic + paper) and rated the environmental friendliness of its packaging on the four-item PEF scale. Finally, they reported their age and gender.

Results

Conjoint Analysis. We obtained individual-specific utilities of each attribute—price, packaging, flavor—using

TABLE 9

STUDY 4A: SAMPLE CHOICE TASK IN THE TWO PACKAGING CONDITIONS



the hierarchical Bayes procedure in Sawtooth separately for the "plastic" and "plastic + paper" conditions (table 10). Packaging and flavor attributes were dummy coded with paper packaging and dark chocolate flavor serving as the baseline. Price was coded linearly ($3.00 = 0; $3.50 = 1; $4.00 = 2). Next, we ran one-way ANOVAs to compare individual-specific attribute utilities across packaging conditions.

Table 10 shows that, as one would expect, price had a negative utility, suggesting that people were significantly more likely to choose low-priced compared to high-priced chocolate bars across conditions. There was no significant difference in the utility of price across the "plastic" and "plastic + paper" conditions ($F(1, 398) = 0.02$, $p = .901$, $\eta_p^2 < 0.001$). Flavor had a negative utility, which was not significantly different from zero, suggesting that people

TABLE 10

STUDY 4A: ATTRIBUTE UTILITIES[a]

Zero-centered utility scores[b]	Plastic condition			Plastic + paper condition		
	M (SD)	*t*-Stat. (Test value = 0)	*p*-Value	*M* (SD)	*t*-Stat. (Test value = 0)	*p*-Value
Price	−56.11 (26.09)	−30.42	<.001	−55.75 (31.99)	−24.64	<.001
Packaging[c]	−37.54 (67.07)	−7.92	<.001	−15.38 (46.57)	−4.67	<.001
Flavor	−8.42 (140.48)	−0.85	.398	−21.39 (167.38)	−1.81	.072

[a]As a robustness check, we also estimated attribute utilities across packaging conditions using an aggregate logit approach for this study and the remaining choice-based conjoint studies 4b and 5. The effect of packaging type on packaging utility was replicated. The results of the analysis are reported in web appendix F. Since logit estimation does not produce individual-level utility estimates, we could not test mediation through PEF scores with the logit approach.

[b]$3.00 price, paper packaging, and dark chocolate flavor served as the baseline attribute levels for utility estimates.

[c]On average, plastic is 37.54 utils worse than paper, whereas plastic + paper is 15.38 utils worse than paper. As such, plastic is 22.16 utils worse than plastic + paper.

were not more likely to choose the dark chocolate flavor over the dark chocolate with strawberries flavor. There was no significant difference in the utility of flavor across the two packaging conditions ($F(1, 398) = 0.71$, $p = .402$, $\eta_p^2 = 0.002$).

Next, we analyzed the utility of packaging across the "plastic" and "plastic + paper" conditions. In the "plastic" condition, the average utility of plastic packaging was negative and significantly different from zero, suggesting that, on average, people were more likely to choose chocolate in paper packaging compared to chocolate in plastic packaging ($M_{\text{plastic}} = -37.54$, SD = 67.07, $t(199) = -7.92$, $p < .001$). Similarly, in the "plastic + paper" condition, the average utility of plastic + paper packaging was negative and significantly different from zero, suggesting that people on average were more likely to choose chocolate in paper than chocolate in plastic + paper packaging ($M_{\text{plastic+paper}} = -15.38$, SD = 46.57, $t(199) = -4.67$, $p < .001$). Importantly, plastic packaging had a greater disutility compared to plastic + paper packaging ($F(1, 398) = 14.72$, $p < .001$, $\eta_p^2 = 0.036$), meaning that participants' propensity to choose chocolate in plastic packaging was lower than their propensity to choose chocolate in plastic + paper packaging.

Perceived Environmental Friendliness. Next, we analyzed participants' PEF scores ($\alpha = 0.96$) of plastic (plastic + paper) packaging. A one-way ANOVA revealed that people perceived plastic packaging to be less environmentally friendly than plastic + paper packaging ($M_{\text{plastic}} = 2.37$, SD = 1.40, vs. $M_{\text{plastic+paper}} = 2.82$, SD = 1.57, $F(1, 398) = 9.29$, $p = .002$, $\eta_p^2 = 0.023$).

Mediation Analysis. For mediation analysis, we used our estimated individual-specific utilities as the dependent variable and participants' PEF scores as the mediator. Mediation with 10,000 bootstrap samples revealed that packaging type had a significant indirect effect on packaging utilities via PEF [$b = 3.81$, SE = 1.47, 95% CI: (1.42; 7.36); see web appendix G for a full summary of mediation results for studies 4a–5]. Thus, consumers were more likely to choose chocolate in plastic + paper (vs. plastic) packaging, because they viewed plastic + paper packaging as more environmentally friendly than plastic-only packaging.

Discussion

This study replicates the effect of packaging type on the environmental friendliness perceptions and demonstrates the implications of this effect for consumers' choice. In this study, we used a choice-based conjoint setup to compare the impact of product packaging on product choice. We observed that addition of a layer of paper to plastic packaging made people more likely to select a chocolate over a chocolate packaged in paper.

In addition, this study addresses the possible limitation of study 3 wherein consumers could have made additional inferences about product quality across the two packaging conditions. In this study, we informed consumers upfront that the evaluated products only differed in terms of their price, flavor, and packaging to minimize possible inferences regarding product quality. As our effect was replicated, we would suggest that our results are not likely driven by quality inferences.

STUDY 4B: IMPLICATIONS FOR CHOICE OF EXISTING BRANDS

Study 4a showed that consumers are less prone to choose a chocolate bar packaged in plastic than to choose a chocolate bar packaged in plastic + paper. It also demonstrated that this effect is mediated by PEF. One possible limitation of study 4a is that the two chocolate bar images only varied in terms of their packaging. While this manipulation allowed us to control for possible confounding effects of brand name and minimized possible additional inferences regarding product quality, it may have prompted our participants to pay more attention to product packaging than

they would have otherwise. To address this concern, study 4b used three real-life brands (Lays, Tyrrells, and Montperal). We then varied the Montperal packaging between-subjects, such that half the participants saw the Montperal brand in plastic packaging and half the participants saw it in plastic + paper packaging.

Critically, instead of informing the participants that the evaluated products varied in terms of price, packaging, and flavor, in this study, we informed them that the evaluated products varied in terms of price, brand, and weight. Thus, in contrast to study 4a, study 4b drew participants' attention to differences across products in terms of brands, rather than in terms of packaging, to ensure greater ecological validity of our results.

In addition, to ensure greater ecological validity, the study used two versions of Montperal packaging that are in fact marketed by the brand. While study 4a presented an "all else equal" comparison, where the only difference between plastic and plastic + paper packaging was the added layer of paper, study 4b used plastic and plastic + paper packaging that varied on more than one dimension but represented real packaging of the focal brand. As such, this manipulation allowed us to test how changes in product packaging that may be implemented by a real company affect consumer choice and environmental friendliness perceptions. As in study 4a, we expected that consumers' propensity to choose the focal brand (i.e., Montperal) would be lower when it came in plastic-only packaging than when it came in plastic + paper packaging.

Method

Four hundred two ProlificCo panelists (M_{age} = 35.67, 60% female) were randomly assigned to one of two conditions (packaging type: plastic vs. plastic + paper). The method was similar to that used in study 4a.

Participants in the "plastic" condition saw Lays, Tyrrells, and Montperal brands, all packaged in plastic. Participants in the "plastic + paper" condition saw Lays and Tyrrells brands packaged in plastic and the Montperal brand packaged in plastic + paper (see table 11 for screenshots of sample choice tasks). In addition to brand, the chips bags varied in terms of price ($2.00, $3.00, $4.00) and weight (3 oz, 5 oz).

Participants made 12 choices among three bags of chips. Then, they saw the Montperal chips and rated the environmental friendliness of their plastic (plastic + paper) packaging on the four-item PEF scale. Finally, they reported their age and gender.

Results

Conjoint Analysis. We obtained individual-specific utilities of each attribute—price, brand, and weight—using the hierarchical Bayes procedure in Sawtooth separately for the "plastic" and the "plastic + paper" conditions (table 12). Because our focus was on the changes in the relative choice propensities of Montperal over the other brands, brand attribute was dummy coded, such that the Montperal brand was coded as 1 and the other two brands were coded as 0. Weight was dummy coded (3 oz = 0, 5 oz = 1). Price was coded linearly ($2.00 = 0; $3.00 = 1; $4.00 = 2). Next, we ran one-way ANOVAs to compare attribute utilities across packaging conditions.

As expected, the analysis revealed that price had a significant negative utility, whereas weight had a significant positive utility (table 12). There was no significant difference in the utility of price or of weight across the "plastic" and "plastic + paper" conditions ($F_{price}(1,400) = 0.85$, $p = .356$, $\eta_p^2 = 0.002$; $F_{weight}(1,400) = 1.57$, $p = .211$, $\eta_p^2 = 0.004$).

Next, we analyzed the utility of brand across the two packaging conditions. In the "plastic" condition, the average utility of the Montperal brand was negative and significantly different from zero, suggesting that people on average were less prone to choose it over Lays and Tyrrells ($M_{plastic} = -47.33$, SD = 83.06, t (200) = −8.08, $p < .001$). In the "plastic + paper" condition, the average utility of the Montperal brand was also negative and significantly different from zero ($M_{plastic+paper} = -29.51$, SD = 86.45, t (200) = −4.84, $p < .001$). Importantly, there was a significant difference in brand utilities across the two packaging conditions ($F(1, 400) = 4.44$, $p = .036$, $\eta_p^2 = 0.011$), suggesting that the disutility of the Montperal brand was greater when this brand came in plastic packaging than when it came in plastic + paper packaging. Put differently, participants were less likely to choose Montperal brand over Lays and Tyrrells when it came in plastic packaging than when it came in plastic + paper packaging.

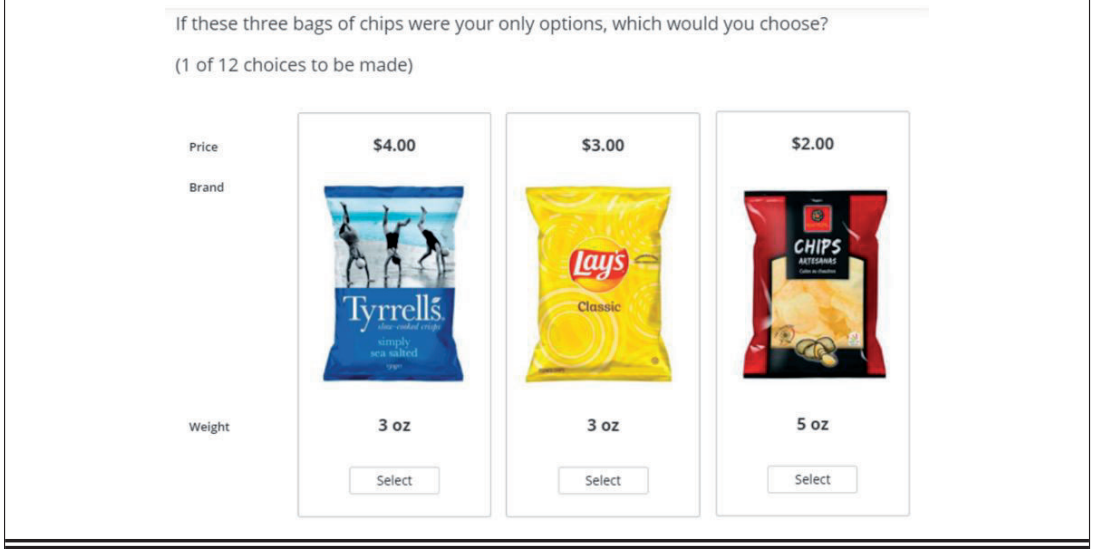
Perceived Environmental Friendliness. Next, we analyzed the PEF scores ($\alpha = 0.96$) of plastic (plastic + paper) packaging. A one-way ANOVA revealed that people perceived plastic packaging to be less environmentally friendly than plastic + paper packaging ($M_{plastic} = 2.72$, SD = 1.35, vs. $M_{plastic+paper} = 4.44$, SD = 1.52; $F(1, 400) = 144.79$, $p < .001$, $\eta_p^2 = 0.266$).

Mediation Analysis. Finally, a mediation analysis with 10,000 bootstrap samples revealed that packaging type had a marginally significant indirect effect on choice via PEF [$b = 10.54$, SE = 5.71, 90% CI: (1.50; 20.33)]. This result indicates that consumers were more likely to choose the Montperal brand when it came in plastic + paper packaging than when it came in plastic packaging, in part, because they viewed the plastic + paper packaging as more environmentally friendly than plastic packaging.

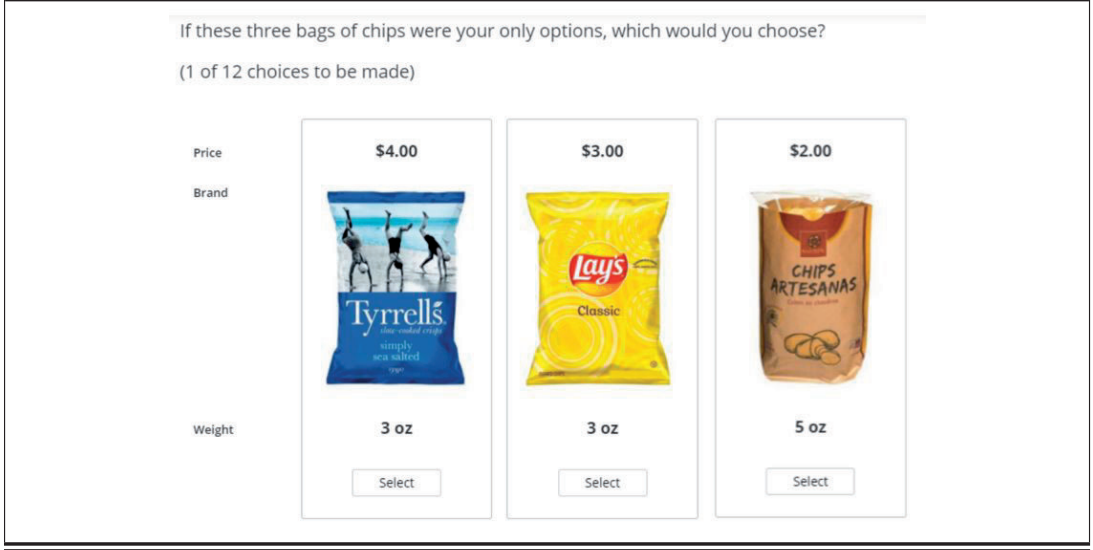
TABLE 11

STUDY 4B: SAMPLE CHOICE TASK IN THE TWO PACKAGING CONDITIONS

Plastic condition



Plastic+paper condition



Discussion

Replicating study 4a results, study 4b shows that consumers become more prone to choose a product when it comes in plastic + paper packaging compared to when it comes in plastic-only packaging. This study used real brands of chips and did not draw participants' attention to variation in product packaging, ensuring greater ecological validity of our findings.

STUDY 5: ON-PACKAGE INTERVENTION

Studies 4a and 4b used between-subjects conjoint experiments to demonstrate that people perceive plastic packaging as less environmentally friendly than plastic + paper packaging. The studies also showed that differences in perceived environmental friendliness of plastic versus plastic + paper translate into a relative disutility and lower

TABLE 12

STUDY 4B: ATTRIBUTE UTILITIES

Zero-centered utility scores[a]	Plastic condition			Plastic + paper condition		
	M (SD)	*t*-Stat. (Test value = 0)	*p*-Value	*M* (SD)	*t*-Stat. (Test value = 0)	*p*-Value
Price	−68.98 (25.74)	−38.00	<.001	−66.66 (24.60)	−38.42	<.001
Montperal brand[b]	−47.33 (83.06)	−8.08	<.001	−29.51 (86.45)	−4.84	<.001
Weight	84.13 (49.50)	24.10	<.001	90.20 (47.55)	26.89	<.001

[a]$2.00 price, Lays and Tyrrells brands, and 3 oz weight served as the baseline attribute levels for utility estimates.

[b]On average, Montperal is 47.33 utils worse than the other two brands when it comes in plastic packaging; it is 29.51 utils worse when it comes in plastic + paper packaging.

choice propensity for products packaged in plastic compared to products packaged in plastic + paper.

Study 5 introduces a managerially relevant intervention that aims to alleviate this bias in environmental friendliness perceptions, making consumers value plastic packaging more than plastic + paper packaging. In addition, the study tests whether, holding everything else equal, we will also observe the relative advantage of plastic + paper packaging when people choose between plastic- and plastic + paper-packaged products.

Method

Students at a public university ($N = 590$, $M_{age} = 19.93$, 51% female) were randomly assigned to one of two conditions (intervention: plastic control vs. plastic sticker). The method was similar to that adopted in studies 4a and 4b.

Participants made 12 choices between two granola bars. Half the participants saw granola bars packaged in plastic + paper or in plastic only (plastic-control condition). The remaining participants saw the bars packaged in plastic + paper or in plastic with a sticker "USDA certified minimal packaging" (plastic-sticker condition; see table 13 for screenshots of sample choice tasks). In addition to packaging, the bars were described on price ($3.00 vs. $3.50 vs. $4.00) and flavor (chocolate chips vs. nuts).

After making 12 choices between granola bars, participants saw the plastic-packaged granola bar (without or with a sticker) and rated its packaging on the four-item PEF scale. Finally, they reported their age and gender.

Results

Conjoint Analysis. We obtained individual-specific utilities of each attribute—price, packaging, and flavor—using the hierarchical Bayes procedure in Sawtooth separately for the "plastic-control" and "plastic-sticker" conditions (table 14). Packaging and flavor attributes were dummy coded with plastic + paper packaging and nuts flavor serving as the baseline. Price was coded linearly ($3.00 = 0; $3.50 = 1; $4.00 = 2). We then ran one-way ANOVAs to compare attribute utilities across the "plastic-control" and "plastic-sticker" conditions.

The analysis revealed that price had a significant negative utility, and the disutility of price was greater in the "plastic-control" condition ($M_{plastic\text{-}control} = -62.74$, SD = 28.33, vs. $M_{plastic\text{-}sticker} = -56.87$, SD = 27.46, $F(1, 588) = 6.54$, $p = .011$, $\eta_p^2 = 0.011$). Flavor had a significant positive utility, meaning that chocolate chips were preferred, on average, to nuts. There was no significant difference in the utility of flavor across the "plastic-control" and "plastic-sticker" conditions ($F(1, 588) = 0.57$, $p = .449$, $\eta_p^2 = 0.001$).

Next, we analyzed the effect of the sticker intervention on the utility of packaging. In the "plastic-control" condition, the average utility of plastic packaging was negative and significantly different from zero ($M_{plastic\text{-}control} = -10.98$, SD = 43.49, $t(294) = -4.33$, $p < .001$), suggesting that, on average, people were less prone to choose the bar in plastic than the bar in plastic + paper. Thus, the lower choice propensity for plastic compared to plastic + paper packaging, observed in the between-subjects studies 4a and 4b, manifested in a within-subjects design as well. Critically, in the "plastic-sticker" condition, the utility of plastic became positive and significantly different from zero ($M_{plastic\text{-}sticker} = 35.05$; SD = 61.48, $t(294) = 9.79$, $p < .001$), suggesting that when the sticker intervention was introduced, on average, people were more prone to select the product in plastic packaging over the product in plastic + paper packaging. Thus, with the sticker intervention, there was a reversal in preference for plastic over plastic + paper.

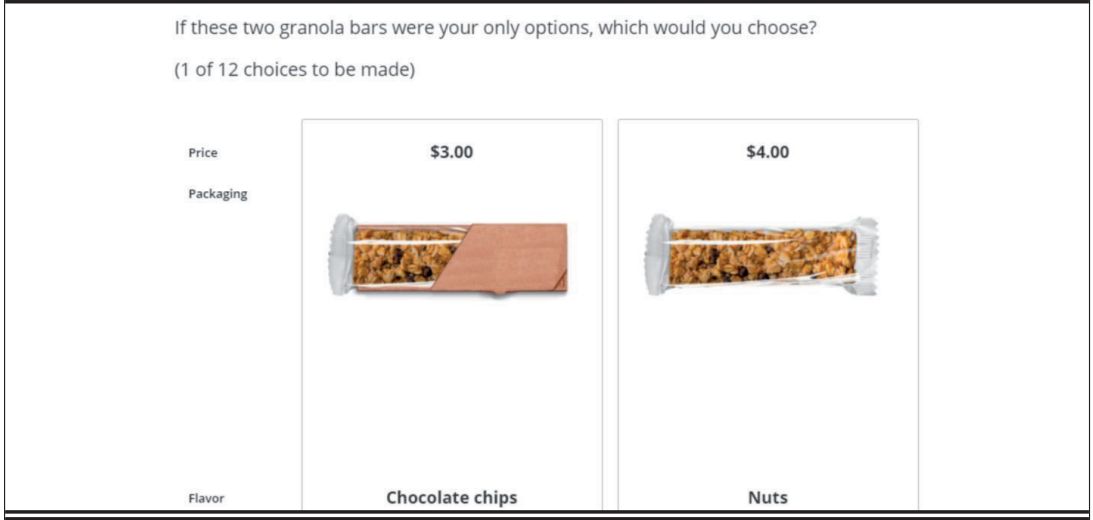
Finally, the difference in packaging utilities was significant across the two intervention conditions ($F(1, 588) = 110.22$, $p < .001$, $\eta_p^2 = 0.158$), suggesting that the bar in plastic packaging was significantly less likely to be chosen in the "plastic-control" condition compared to the "plastic-sticker" condition.

Perceived Environmental Friendliness. Next, we analyzed the PEF scores ($\alpha = 0.95$) of plastic packaging across the "plastic-control" and "plastic-sticker" conditions. A

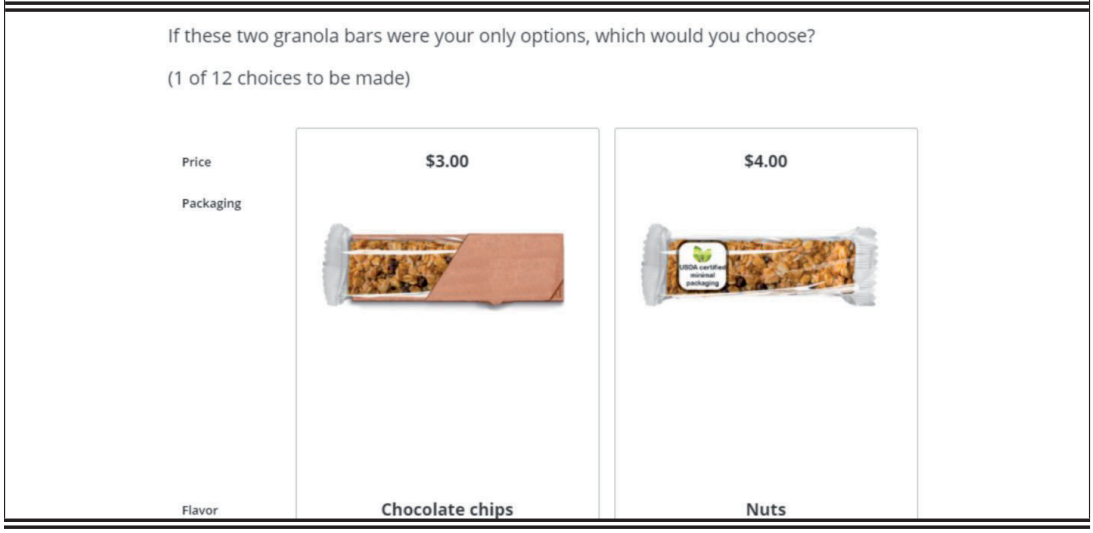
TABLE 13

STUDY 5: SAMPLE CHOICE TASK IN THE TWO INTERVENTION CONDITIONS

Plastic-control condition



Plastic-sticker condition



one-way ANOVA revealed that people perceived plastic packaging to be less environmentally friendly in the "plastic-control" condition than in the "plastic-sticker" condition ($M_{\text{plastic-control}} = 3.08$, SD = 1.47, vs. $M_{\text{plastic-sticker}} = 4.58$, SD = 1.47, $F(1, 588) = 152.10$, $p < .001$, $\eta_p^2 = 0.206$).

Mediation Analysis. A mediation analysis with 10,000 bootstrap samples showed that packaging intervention had a significant indirect effect on choice via PEF [$b = 9.89$, SE = 2.58, 95% CI: (5.14; 15.22)]. This result indicates that our "minimal packaging sticker" intervention affected the choice propensities for plastic packaging by making consumers view plastic packaging as more environmentally friendly.

Discussion

Study 5 introduced a managerially relevant on-package intervention to attenuate the PEF bias. The results show

TABLE 14

STUDY 5: ATTRIBUTE UTILITIES

Zero-centered utility scores[a]	Plastic-control condition			Plastic-sticker condition		
	M (SD)	*t*-Stat. (Test value = 0)	*p*-Value	*M* (SD)	*t*-Stat. (Test value = 0)	*p*-Value
Price	−62.74 (28.33)	−38.04	<.001	−56.87 (27.46)	−35.57	<.001
(Plastic) packaging[b]	−10.98 (43.49)	−4.33	<.001	35.05 (61.48)	9.79	<.001
Flavor	118.47 (99.43)	20.46	<.001	112.45 (93.36)	20.69	<.001

[a]$3.00 price, plastic + paper packaging, and nuts flavor served as the baseline attribute levels for utility estimates.

[b]On average, plastic is worse than plastic + paper packaging by 10.98 utils in the plastic-control condition. Plastic is better than plastic + paper packaging by 35.05 utils in the plastic-sticker condition.

that addition of a "minimal packaging" sticker not only attenuates but also reverses the effect of adding paper to plastic packaging on choice. In the "plastic-control" condition, plastic packaging had a negative utility compared to the plastic + paper baseline, meaning that people were less likely to choose plastic-packaged granola bars than plastic + paper-packaged granola bars. Importantly, in the "plastic-sticker" condition, plastic had a positive utility, meaning that people became more prone to choose plastic-packaged granola bars than plastic + paper-packaged granola bars.

GENERAL DISCUSSION

Across eight studies, we show that objectively less environmentally friendly plastic + paper packaging is systematically perceived as more environmentally friendly compared to plastic-only packaging. We refer to this effect as the PEF bias in packaging evaluations. Studies 1a and 1b provide evidence of the PEF bias and show that the effect manifests in lab and online settings when plastic is visible upfront or revealed later.[2] Next, studies 2a and 2b test two theoretically relevant boundary conditions of the PEF bias. Study 2a shows that the effect is stronger when the proportion of paper in product packaging increases; and study 2b shows that the effect is stronger among people with stronger "paper = good, plastic = bad" beliefs. Studies 3–4b establish the downstream consequences of the PEF bias for consumer willingness to pay (study 3) and choice (studies 4a and 4b). Study 5 introduces a managerially relevant intervention, wherein addition of a "minimal packaging" sticker to plastic packaging increases the environmental friendliness perceptions of plastic-only packaging, making people more likely to choose plastic-packaged products over their plastic-plus-paper overpackaged counterparts.

To assess the evidential value of the studies reported in the paper, we used the p-curve method (Simonsohn, Nelson, and Simmons 2014). To conduct the p-curve analysis, we used the seven studies for which the PEF scores for both the "plastic" and "plastic + paper" conditions were available (web appendix K). The analysis indicated that the reported studies have evidential value, with the power of tests included in the p-curve estimated at 99%, after correcting for selective reporting.

Theoretical Implications

Product Packaging and Consumer Decisions. Our research contributes to the packaging literature in marketing. Extant research has examined several dimensions of product packaging design, attesting to its important role in consumer judgments and decisions. For instance, packaging size (e.g., small vs. large; single serve vs. multi-serve) is known to affect consumers' perceptions of product efficacy (Ilyuk and Block 2016) and consumption amounts (Argo and White 2012; Coelho do Vale et al. 2008). Graphic design of product packaging (e.g., pale vs. bright coloring; high vs. low image placement) has been shown to influence consumers' purchase intentions and willingness to pay (Mai et al. 2016; Sundar and Noseworthy 2014). Finally, the presence of on-package labeling (e.g., low-fat; Nutri-score food labels) is suggested to affect products' purchase and consumption rates (Dubois et al. 2021; Wansink and Chandon 2006). We add to the above line of work by examining how packaging composition—plastic versus plastic + paper—shifts consumers' packaging evaluations and how these evaluations affect product valuation and purchase decisions.

Sustainable Consumer Behavior. This research also contributes to the growing stream of literature in marketing and sustainability by revealing *perceptual* barriers to sustainable consumption. Extant research highlights the challenge to increase sustainable consumer behavior (White

2 Studies B and C (web appendices H and I) further attest to the generalizability of the PEF bias and show that the bias emerges for both food and non-food categories and that it holds in stimulus- and memory-based evaluations. Only when additional paper packaging is conspicuously superfluous (e.g., when paper packaging is four times larger than the product), do we find that consumers perceive plastic-only packaging as more environmentally friendly than the plastic + paper option (study D, web appendix J).

et al. 2019). While consumer inaction is one of the barriers to sustainable behavior, we show that consumers' systematically biased perceptions of environmental friendliness can also mitigate pro-environmental outcomes.

We find that environmental friendliness judgments of packaging are based on "paper = good, plastic = bad" beliefs. We further demonstrate that these beliefs can bias environmental friendliness judgments and influence consumers' willingness to pay and choice. As such, in addition to shedding light onto processing of environmental information in the marketplace, our research underscores the importance of studying differences between consumer perceptions of environmental friendliness and objective reality.

Alternative Accounts of the Perceived Environmental Friendliness Bias

While our studies provide evidence of the underlying mechanism of the PEF bias and probe several alternative explanations, there are at least three additional plausible alternative accounts of our results.

Packaging Quality Inferences. One may argue that the addition of paper packaging to plastic packaging prompts inferences about the quality of plastic used in the "plastic + paper" condition. For example, one may assume that products in plastic + paper packaging are wrapped in thinner layers of plastic compared to products packaged in plastic alone. Alternatively, people may infer that the product manufacturer is generally more committed to use eco-friendly packaging materials in the "plastic + paper" condition. As a result, they may assume that the plastic used in the "plastic + paper" condition is more environmentally friendly than that used in the "plastic" condition. To probe this additional alternative account, we ran a follow-up study (study D, web appendix J). In this study, we measured the perceived environmental friendliness of product packaging (plastic vs. plastic + paper). Then, on a separate screen, we reminded the participants that the product in the preceding task used plastic packaging and asked them to estimate the number of months it would take that plastic packaging to disintegrate in a landfill. The analysis did not reveal significant differences across the "plastic" and "plastic + paper" conditions in terms of disintegration time for the plastic. As such, even though it is possible that additional paper packaging sometimes makes plastic packaging seem more environmentally friendly, we do not think that this process can account for the PEF bias.

Changes in (Inferred) Objective Environmental Friendliness. One may also argue that additional paper packaging increases perceived environmental friendliness not because consumers fail to factor in the increased amount of packaging in their PEF evaluations, but because they think that the additional packaging increases the objective environmental friendliness of packaging overall. For example, one could think that plastic + paper packaging is objectively more environmentally friendly because it preserves the packaged products better and, thus, reduces possible waste. To probe this account, we ran a follow-up study where three groups of participants rated granola bar packaging from study 1a (study E, web appendix L). One group rated plastic packaging, and one group rated plastic + paper packaging. Critically, a third group rated both the plastic and plastic + paper packaging, with the two packaging types presented on the same screen in a random order. We replicated the PEF bias in the between-subjects evaluation. In the within-subjects evaluation, where people saw and evaluated plastic and plastic + paper packaging side by side on the same screen, the PEF of the two packaging types was not significantly different. Had the effect of product type been driven by preservation-related concerns or by other beliefs about objectively greater environmental friendliness of packaging with additional layers of paper, we would expect the effect of packaging type to emerge in within-subjects evaluations. This, however, was not the case.

Counterfactual Thinking. Finally, one could argue that the PEF bias emerges because plastic and plastic + paper packaging types evoke different counterfactual thoughts. When seeing plastic packaging, people may think that the alternative to packaging a product in a layer of plastic is packaging it in a layer of paper. By contrast, when seeing plastic + paper packaging, people may be more prone to consider the alternative where the product is packaged in two layers of plastic. This means that in our studies, in the "plastic" condition, the participants may have been comparing the focal packaging to a subjectively environmentally friendly "paper" alternative. In the "plastic + paper" condition, the participants may have been comparing the focal packaging to a subjectively environmentally harmful "plastic + plastic" alternative. As a result of this difference in the evoked comparison standards, plastic packaging would be perceived as less environmentally friendly than plastic + paper packaging.

While counterfactual thinking could have affected the results in studies 1a–3, where participants evaluated a given packaging in isolation, we think it is less likely to have affected our results in studies 4a and 4b. For example, in study 4a, the participants were making choices between chocolate bars packaged in paper or plastic in the "plastic" condition and between bars packaged in paper or plastic + paper in the "plastic + paper" condition. After that, the participants rated the environmental friendliness of plastic or of plastic + paper packaging. We think that participants in both the "plastic" and "plastic + paper" conditions were likely to use paper packaging as a comparison standard for their PEF evaluation, because this was the packaging they saw alongside the focal plastic (plastic + paper) packaging

in the preceding choice tasks. Similarly, in study 4b, the participants likely considered plastic packaging as a comparison standard across the "plastic" and "plastic + paper" conditions, because they repeatedly saw plastic-packaged Lays and Tyrrells chips alongside the focal Montperal chips package in the choice tasks. Because the PEF bias emerged when participants were likely relying on the same, explicitly provided, comparison standards, it is unlikely that counterfactual thinking is a key driver of our results.

In sum, we find initial evidence against several alternative accounts of our results. However, it is possible that the PEF bias is multiply determined, and we hope that future research will further probe the above and other accounts of the PEF bias.

Practical Implications

From a managerial perspective, our research provides important insights for companies aiming to boost the perceived environmental friendliness of their products. In their responses to a 2022 Deloitte consumer survey on sustainability beliefs, over half the respondents said they would consider a product sustainable if it used minimal or recyclable packaging (Deloitte 2022). Our results reveal a different pattern: we find that overpackaged products can be perceived as more sustainable compared to minimally packaged ones when excessive packaging is made of paper. We show that that additional paper packaging increases perceived environmental friendliness across multiple contexts: for food and non-food products, when both paper and plastic are visible and when plastic is initially hidden and revealed later. As such, our results alert companies to the potential disparities between consumers' self-reported attitudes to overpackaging in general and their evaluations and choices of specific overpackaged products.

Relatedly, our findings are of relevance for companies working to increase the objective environmental friendliness of their products by reducing overpackaging. As noted earlier, companies such as Kiehl's and Nestle already eliminate unnecessary paper packaging in some of their products. Other examples include Amazon that recently required its vendors to make their paper box packaging more compact and environmentally friendly (Gasparro 2019) and British supermarket chain Tesco, which launched a trial to eliminate needless toothpaste packaging for private label and national brands (Tesco 2022). These initiatives can curtail the environmental harm from single-use paper production and disposal and reduce the ecological footprint from product transportation. Yet, our research suggests that these initiatives need to come in conjunction with front-of-pack labeling to boost consumers' environmental friendliness perceptions and choice. More generally, companies should not assume that consumers will readily incorporate reduced amounts of packaging into their judgments. Rather, consumers need additional communications about companies' minimal packaging initiatives to make more sustainable product choices.

Next, our results have implications for companies aiming to boost the objective environmental friendliness of their packaging by eliminating plastic packaging and switching to paper-only packaging. Our choice-based conjoint study 4a shows that when consumers choose between an ostensibly more environmentally friendly paper-packaged option and a less environmentally friendly plastic-only- or plastic + paper-packaged option, they see greater disutility in plastic-only packaging. By extension, they are also willing to pay a greater premium for paper-only packaging when it is presented alongside plastic-only packaging than when it is presented next to plastic + paper packaging. Taken together, these results suggest that paper-only brands may be able to attract more consumers and command higher premiums if they position themselves against plastic-only alternatives, as opposed to overpackaged plastic + paper options. Relatedly, we show that minimal packaging can benefit companies using paper-only packaging. For them, superfluous paper packaging creates additional costs without improving consumers' environmental friendliness perceptions (study A, web appendix D), rendering minimal packaging more attractive.

Finally, our findings have implications for package-free retailers, such as Precycle in the United States and Pieter Pot in the Netherlands. Objectively, these stores are more accurately characterized as package free, as they do not feature any single-use packaging, with consumers getting their produce in reusable containers. However, these retailers can also be described as plastic free because they avoid single-use plastics. Our results suggest that the "package-free" positioning, one currently adopted by Precycle, for example, may not be as effective as "plastic-free" positioning, because consumers may not consider additional packaging as problematic and instead focus on minimizing the proportion of plastic in their purchases.

To conclude, superfluous packaging, where unnecessary paper is added to plastic packaging, is common across product categories and geographic markets. Companies may use additional paper packaging to communicate greater environmental friendliness and naturalness of their products or to avoid the potential costs of packaging adaptations under minimal packaging. Critically, our research shows that, driven by the PEF bias, consumers may reward companies packaging products with unnecessary paper, showing higher willingness to pay and greater choice propensities for overpackaged items. Thus, it is important to develop interventions that can correct consumer perceptions of environmental friendliness and make them more likely to choose objectively environmentally friendly products.

This article attempts to bring attention to consumer perceptions of environmental friendliness, to biases in these

perceptions, and underscores the need for interventions correcting such biases. We hope that our research will inspire more work in this area.

DATA COLLECTION INFORMATION

Data for study 1a were collected at the Tilburg University lab in February 2020. Data for studies 1b and 2a were collected via Mechanical Turk in July 2022 and November 2020, respectively. Data for studies 2b, 3, 4a, and 4b were collected via ProlificCo between February and May 2022. Data for study 5 were collected at the University of Michigan lab in February 2022. The first author supervised the data collection and analyzed the data for studies 1a, 2b, 3, 4a, 4b, and 5. The third author supervised the data collection and analyzed the data for studies 1b and 2a. The anonymized data files, syntax files, and study stimuli are stored at https://researchbox.org/712.

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