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To see or not to see: The effect of observability of the recycled content on consumer adoption of products made from recycled materials

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ABSTRACT

Despite their environmental benefits, products made from recycled materials are not readily adopted. Prior studies focused on improving consumer adoption via product attributes and marketing elements, but the impact of product appearance remains a gap in the literature. This research contributes by investigating how observability of the recycled content, as a product appearance intervention, influences consumer adoption of products made from recycled materials. Building on the integrated conceptual framework for consumer response to the visual domain in product design, the findings from three experiments ($n_1=162$, $n_2=219$, $n_3=320$) demonstrate that observability of the recycled content leads to higher purchase intentions (Studies 1, 2 and 3). The underlying process for this effect is that these observable appearance cues trigger identity signaling (Studies 2 and 3). This effect is stronger when the consumption context is public (Study 3). These findings enable practitioners to enhance adoption of these products through altering their appearance.

1. Introduction

The growing recognition of the environmental and social impacts of traditional production and consumption patterns (Kotler, 2011; White et al., 2019) incentivizes firms to develop and market products by making use of recycled materials. The use of recycled materials mitigates environmental degradation and contributes to a circular economy by lowering waste, reducing reliance on virgin resources, and conserving energy, thereby fostering a more sustainable approach to production and consumption. In this regard, past research has studied how different product attributes and marketing elements (e.g., quality, Sun et al., 2018; functionality, Magnier et al., 2019; contamination risk, Meng and Leary, 2021; eco-friendliness of the packaging, Testa et al., 2021; past identity salience, Kamleitner et al., 2019; presence of eco-labels, Wang et al., 2022) influence consumer adoption of products made from recycled materials (see summary of prior literature in Table A1 of Appendix A).

Despite the recognized need for sustainability and its appeal to consumers, negative perceptions often impede adoption of products made from recycled materials (Polyportis et al., 2022), underscoring the need for firms to devise novel, more effective strategies for shifting

consumer responses. In this regard, the impact of product appearance—a critical factor in shaping consumer preferences—on adoption of products made from recycled materials remains notably underexplored in prior research, highlighting a crucial research gap. This is surprising considering that product appearance is a “critical determinant of consumer responses and product success” (Crilly et al., 2004, p. 547) as it, being part of the product design, can evoke different cognitive and affective responses (Creusen and Schoormans, 2005; Mobley et al., 1995; Mugge et al., 2018). Consequently, product appearance can also be valuable for positively influencing consumer adoption of products made from recycled materials. By strategically designing product appearance to resonate with consumers’ environmental preferences and values, companies can elevate the desirability of products made from recycled materials, thereby encouraging enhanced adoption. The current gap in the literature thus calls for further investigation on the potential impact of product appearance interventions to foster consumer adoption of products made from recycled materials. Specifically, we focus on the importance of the observability of the recycled content in the product appearance since it, being part of the product appearance, can directly affect consumers’ perceptions of products made from recycled materials, and eventually the market appeal of such products.

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Observability of the recycled content is defined as the degree to which cues, such as distinctive patterns or textures, are present in the product appearance and communicate that the product is made from recycled materials. Market examples demonstrate that products made from recycled materials can be designed either with or without observable recycled content. For instance, Pyrasied, a Dutch distributor of sustainable acrylic plastics, advertises design sheets made from plastic waste, characterized by visually observable wave-and-dot patterns that highlight the recycled plastic material ((Pyrasied, 2023); <https://pyrasied.com/en/brands/smile-plastics/>). In a similar vein, the recycled nature of the Iina Vuorivirta marbled decorative vases of IKEA is observable via the glass scraps ((The Associated Press 2017); <https://www.denverpost.com/2017/01/19/furniture-decor-designers-sustainable-chic/>), while observable coffee trays made from recycled coffee packages are produced by Better Future Factory from Rotterdam (Better Future Factory, n.d.; cf. Fig. 1).

In contrast, other firms produce recycled products with a conventional look that does not communicate these sustainable properties. For instance, Better Earth, a South African company that provides eco-friendly products, commercializes bottles made from recycled plastic without any observable cues of recycled content (Better Earth, n.d.). To the best of our knowledge, no prior research has investigated the effect of observability of the recycled content on consumer responses. Consequently, there is a need to examine the effectiveness of the observability of the recycled content as a product appearance intervention.

In this context, our research seeks to address several questions. First, we investigate whether the observability of the recycled content in the appearance of products made from recycled materials leads to higher consumer adoption. Prior research suggested that consumers can interpret the sustainability of a product based on appearance cues (Magnier and Schoormans, 2015; Polypartis et al., 2023). Thus, if the recycled content of a product is not observable, there is a risk that the sustainability aspects of the product may go unnoticed by consumers. Nonetheless, other streams of research demonstrate that the presence of cues conveying sustainability may conditionally backfire (e.g., Achabou and Dekhili, 2013; Acuti et al., 2022; Luchs et al., 2010), a phenomenon particularly evident in the sphere of sustainable innovations, in which consumers often expect a trade-off in choosing between environmental benefits and product functionality (Luchs & Swan, 2011; (Luchs et al., 2012; Skard et al., 2021)). Hence, it appears worthwhile to investigate whether and under which conditions the observability of the recycled content may serve as a useful tool for firms to increase consumer adoption of products made from recycled materials.

The present research builds on the seminal conceptual framework of

(Crilly et al., 2004) on communication through design to empirically investigate the effect of observability, as part of the product appearance, on consumer responses (i.e., purchase intentions) towards products made from recycled materials. The theoretical contribution of this research is multifold. First, we extend existing research on the consumer semantic interpretations of product appearance cues (Crilly et al., 2004; Crilly et al., 2009; Mugge et al., 2018) by empirically investigating whether observable cues of recycled content communicate the product's sustainable attributes, leading to higher adoption. Second, we investigate the underlying mechanism of the effect of observability of the recycled content on the adoption of products made from recycled materials. In this regard, we leverage the perspective of (Crilly et al., 2004) on the symbolic associations of product design, by highlighting the social implications of identity signaling through the possession of sustainable products. Observability of the recycled content can act as a signal of an individual's personality and green consumption preference, enabling them to convey their identity to others (Berger and Heath, 2007; Griskevicius et al., 2010). Third, a boundary condition related to the social setting (i.e., privacy of the consumption context), which is proposed by (Crilly et al., 2004) as a situational factor, is defined for these effects.

Based on the above research objectives, two research questions are defined:

RQ1: Does observability of the recycled content affect consumer adoption of products made from recycled materials?

RQ2: How does the proposed underlying mechanism —identity signaling— and the boundary condition —social setting— affect the impact of observability of the recycled content on consumer adoption?

Three experimental studies are presented to address the above research questions. By using controlled experimental designs, we can systematically manipulate and measure the impact of observability on consumer adoption of products made from recycled materials, while ruling out other effects. This approach not only offers stronger evidence for causality, but also allows for an in-depth understanding of how and why observability influences consumer adoption, thereby providing actionable insights for managers. Practitioners may gain useful insights into how to optimise consumer adoption of products made from recycled materials by strategically altering the observability of the recycled content of these products.



Fig. 1. Observable coffee trays made from recycled coffee packages by Better Future Factory. <https://betterfuturefactory.com/project/selecta-coffee-tray>.

2. Theoretical background and hypotheses

2.1. Observability of the recycled content and purchase intentions

Observability of the recycled content can facilitate consumer understanding of the associated environmental benefits, eventually serving as a catalyst for consumer demand towards such sustainable offerings. Central to our argumentation is the conceptual framework for consumer response to the visual domain in product design of Crilly et al. (2004), who describe design as a process of communication. This theoretical framework extends previous literature on responses to product appearance (Bloch, 1995) by illustrating how designers intentionally modify design aspects, such as appearance elements, to convey specific message(s) via the product, serving as a medium for these messages. Consumers then perceive the message(s), leading to cognitive, affective or behavioral reactions. Product appearance triggers three main cognitive responses in consumers: aesthetic impressions, semantic interpretations, and symbolic associations. Aesthetic impressions are defined as the sensations deriving from the perception of product (un)attractiveness. Symbolic associations, on the other hand, relate to the meanings and social significance a product conveys about its user or owner through its design (Crilly et al., 2004).

Semantic interpretations are defined as the “evaluation of a design’s apparent utility and perceived qualities” (Crilly et al., 2004, p. 559). Semantic interpretations convey meaningful product information about the product’s associated attributes through appearance cues. Hence, firms communicate with consumers through products on multiple levels, with each product appearance element communicating specific messages about the product’s perceived qualities. Through this lens, consumers interpret product attributes from its product appearance elements, shaping their preferences and choices.

The theoretical framework of (Crilly et al., 2004) sets the stage for understanding how product appearance cues, which visually convey the sustainable (i.e., recycled) nature of the product triggers consumer responses through the abovementioned semantic interpretations. The observability of recycled content can serve as an important cue for semantic interpretations, enabling consumers to understand the focal product attribute (i.e., sustainability), based on previously encountered associations and prior knowledge. For instance, a recycled cardboard look in food packaging can be perceived as a cue of its sustainability (Magnier et al., 2016). Correspondingly, observability of the recycled content, for instance, through specific patterns on a product made from recycled materials, can communicate the recycled nature of the product, and therefore bring associations of sustainability through semantic interpretation. Thus, a product appearance with colour variations or dot patterns can denote the fact that its material has been recycled from different types of plastic.

Based on the previous theoretical grounds, it becomes evident that semantic interpretations play a crucial role in how consumers perceive and respond to products made from recycled materials. Semantic interpretations deriving from observable cues of recycled content are associated with the related environmental benefits. Thus, consumers are expected to interpret the observability of the recycled content as a product appearance element that effectively signals the product sustainability credentials.

Past research has demonstrated that consumers generally respond positively to products with environmental benefits, resulting in increased purchase intentions (e.g., (Calvo-Porrall and Lévy-Mangin, 2020)). Consequently, consumers are expected to positively evaluate the environmental benefits of products with observable recycled content and to respond in terms of improved purchase intentions (benefits-intention relations; (Ajzen, 1991; Fazio, 2007)).

The above effect is not expected to hold for products with a more conventional appearance that lack an observable cue of recycled content. Then, product sustainability will not be salient, and consumers will be less likely to semantically interpret its sustainable nature, thus

responding in terms of lower purchase intentions.

Hence, pertaining to RQ1, it is hypothesised that:

H1. Purchase intentions for products made from recycled materials with observable recycled content are higher than purchase intentions for their non-observable counterparts.

2.2. On the mediating effect of identity signaling

The ensuing Sections 2.2 and 2.3 relate to RQ2, on the underlying mechanism and boundary condition of the effect of observability of the recycled content on purchase intentions of products made from recycled materials.

In line with the framework of Crilly et al. (2004), we argue that, apart from the semantic interpretations discussed previously, observability of recycled content elicits symbolic associations, which are hereby proposed as the underlying mechanism of the effect of observability of the recycled content on purchase intentions. Symbolic associations are defined as the perception of what a product says about its owner or user: the personalized social significance that a product conveys about its user or owner through its appearance. Specifically, this theoretical framework elucidates that products are not mere consumption objects or sources of semantic interpretations, but also bearers of self-expression, *symbolizing the identity* of their users. This identity symbolism associated with product appearance allows the expression of unique aspects of one’s personality, encompassing personal qualities, values, and attributes (Crilly et al., 2004). Based on this framework, we discern that the generation of socially oriented motives—driven by the desire for *identity signaling* through purchase and possession of a product—can drive consumers towards sustainable choices. Essentially, these motives are shaped by the product’s appearance, which can facilitate the projection of a positive image to others. This aligns with findings from the fields of consumer and social psychology, underlining that people tend to engage in behaviors with reputational (Jaeger and van Vugt, 2022) or altruistic (Durkee et al., 2020) benefits as such benefits can convey status and are viewed positively by others (Berger and Heath, 2007; Griskevicius et al., 2010).

Based on the above discussion, we put forward that the observability of the recycled content in a product leads to symbolic associations (Crilly et al., 2004) through identity signaling. As consumers associate the sustainable nature of products made from recycled materials based on the presence of observable cues of the recycled content, the possession of such products can help in revealing their signaling patterns and improve the individual’s image (Berger and Heath, 2007; Griskevicius et al., 2010). Thus, the observability of the recycled content can help to signal a person’s environmental consciousness and related values of sustainability as part of one’s identity to others (Trudel, 2019) and facilitate environmental consumption as a positive social marker (Magnier et al., 2019).

In turn, eliciting status and reputational motives through identity signaling can shape behavioral intentions towards sustainable or recycled products (Griskevicius et al., 2010). Therefore, observability of the recycled content can have a positive effect on purchase intentions for products made from recycled materials through activating the motive of identity signaling to others:

H2. Identity signaling mediates the effect of observability of the recycled content on consumer purchase intentions for products made from recycled materials.

After delineating the mediating role of identity signaling, it is also important to explore boundary conditions. (Crilly et al., 2004) referred to situational factors that can influence the effects of product appearance on subsequent consumer responses. In this regard, the next section transitions to focusing on a moderating factor, namely the privacy of the consumption context as an aspect of the social setting, thus broadening our perspective of the effects of the observability of the recycled content

on identity signaling and consumer purchase intentions.

2.3. The moderating role of the privacy of the consumption context

The integrated conceptual framework of Crilly et al. (2004) proposed a specific situational factor, namely the social setting within which products are consumed, that can moderate the effects of product appearance on consumer responses, eventually shaping consumer preferences.

Indeed, aligned with (Crilly et al., 2004), individuals tend to engage in more prosocial behavior when their actions are visible to others (Brick et al., 2017; Kristofferson et al., 2014). Consumption patterns can be signalled more conspicuously in a lower-privacy context when family, friends and others can see these (Griskevicius et al., 2010). Status motives lead people to be sensitive to what their behaviors might signal to others when such behavior is observable (Griskevicius et al., 2010; Harbaugh, 1998). For instance, if a consumer purchases a sustainable product for use in a lower-privacy setting (e.g., a table made from recycled plastic for their front garden, in view of visiting family and friends), the signaling aspects of their purchase decision are highly salient. In contrast, if a consumer were to buy the same product for use in their private bedroom, the signaling aspects of the decision are expected to be much less salient. In a similar vein, (Brick et al., 2017) unveiled that signaling one's environmental identity more strongly predicts pro-environmental behaviors when such behaviors are visible to others. Accordingly, (Berger, 2019) found that consumers demonstrate higher willingness to pay for sustainable products when the sustainable product choice is public rather than private.

Drawing on the fact that the observability of the recycled content can trigger identity signaling to consumers through symbolic associations (Section 2.2), and the proposed moderating role of the social setting on consumer response (Crilly et al., 2004), it is expected that the effect of observability of the recycled content on identity signaling and purchase intentions will be greater when the consumption is performed in a low-privacy than in a high-privacy context (i.e. more or less visible to others). Consequently, it is hypothesised that:

H3. The privacy of the consumption context (i.e., low vs. high) moderates the effect of observability of the recycled content on the identity signaling of products made from recycled materials.

H4. The privacy of consumption context (i.e., low vs. high) moderates the effect of observability of the recycled content on consumer purchase intentions for products made from recycled materials.

2.4. Overview of the present studies

We test our hypotheses through three experimental studies. Study 1 tests the effect of observability of the recycled content on the purchase intentions for products made from recycled materials (H1). Study 1 also intends to examine whether the positive effect of the observability of the recycled content is strictly associated with the recycled nature of the products, and therefore to eliminate the possibility that the effect was caused by the specific appearance pattern or a general positive impression. Study 2 attempts to replicate the positive effect of the observability of the recycled content for a different product and manipulation and to examine identity signaling as the underlying mechanism of the effect of observability on purchase intention (H2).

Study 3 investigates the moderating role of the privacy of the consumption context on identity signaling and purchase intentions (H3 and H4).¹

Fig. 2 below illustrates the conceptual model of the present research.

3. Study 1

3.1. Method

3.1.1. Study design

This study employed a 2 (observability: non-observable vs. observable) × 2 (type of material: virgin plastic vs. recycled plastic) between-subjects experimental design. We selected benches as a product category because we observed that bench manufacturers sometimes use recycled materials in their products.

3.1.2. Development of the stimuli

A trained designer was hired to design and render the bench images included in all conditions. A 3D drawing was created based on photographs of commonplace benches. In the non-observable conditions, no observable pattern was applied. Subsequently, the product appearance was altered in such a way as to achieve the manipulation of observability of the recycled content while minimizing variations in the product's aesthetics. In the observable conditions, a pattern with waves was applied to the bench appearance. The inspiration for this pattern was based on real-world corporate practices. For instance, patterns with colour variation in the material can indicate that it has been recycled from different types of plastic. All images had the same colour and viewpoint. Brand/company names were not used in any condition to avoid any confounding effects (Appendix C, Fig. C1).

3.1.3. Pretest

To ensure that the manipulation of the observability of the recycled content worked and to avoid any confounding effects of attractiveness in the main study, stimuli were pretested with a Prolific sample ($n = 63$). Observability of the recycled content was measured using three items adapted from (Magnier et al., 2019) (1 = strongly disagree; 7 = strongly agree; $\alpha = 0.92$; see Table B1 of Appendix B). An independent samples *t*-test indicated that its manipulation was successful: Respondents in the observable condition rated the product as being significantly more observable as being made from recycled plastics ($M = 3.22$, $SD = 1.43$) compared to respondents in the non-observable condition ($M = 2.47$, $SD = 1.51$), $t(61) = -2.04$, $p < 0.05$. Attractiveness was measured with three items on a semantic differential scale adapted from (Bell et al., 1991) (see Table B1 of Appendix B; $\alpha = 0.94$). No significant differences for attractiveness were found between the stimuli of the observable ($M = 4.17$, $SD = 1.53$) and the non-observable conditions ($M = 4.59$, $SD = 1.24$), $t(61) = 1.18$, $p = 0.24$, suggesting that no confounding effect of attractiveness was present in the stimuli.

3.1.4. Respondents and procedure

A total of 162 (53.7 % males, 465.7 % females, 0.6 % other, $M_{age} = 28.20$, $SD_{age} = 9.05$) Prolific users took part in the main study. Respondents were randomly allocated to one of the four conditions. Specifically, respondents in the recycled plastic conditions read a scenario in which they were instructed to imagine that they were interested in purchasing a bench for their garden or balcony. Next, they read the following text: "While comparing options online, you encounter the

¹ To determine if the samples and observed effects achieved statistical power consistent with established standards (power level > 0.80) to minimize the risk of Type II errors (Cohen, 1992), we conducted power analysis tests using the G*Power 3 software (Faul et al., 2007). The tests revealed that acceptable levels of power were achieved for the hypothesized effects (power = 0.84 for Study 1, power = 0.99 for Studies 2, 3).

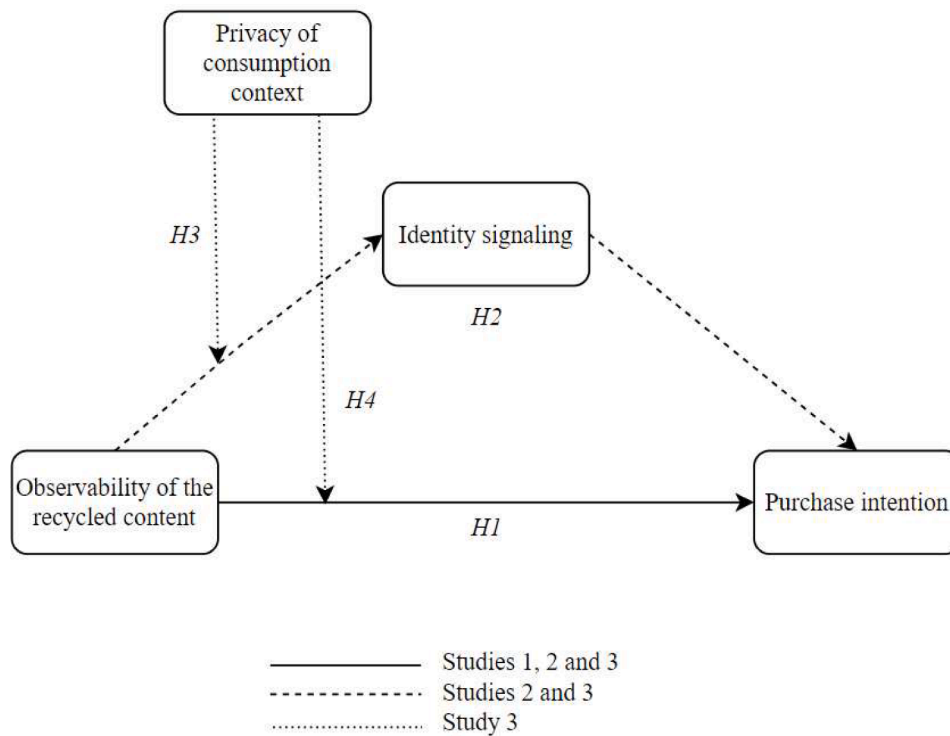


Fig. 2. Conceptual model. The main effect of the observability of the recycled content on purchase intention (H1; Studies 1–3), the mediating role of identity signaling (H2; Studies 2, 3), and the moderating role of privacy of the consumption context on identity signaling and on purchase intention (H3 and H4; Study 3).

following bench. This bench is commercialised by a company that started to use recycled plastic from household waste as the main material for their products. The bench is 150 cm wide, it is easy to clean, and it is resistant to rot and splintering. It does not discolour, and it has a lifetime guarantee”. Respondents were then instructed to examine the image of the bench. Respondents in the virgin plastic conditions read a similar scenario, with the only difference that they read: “This bench is commercialised by a company that uses plastic as the main material for their products”. After assessing the scenario, respondents completed measures of purchase intention, an attention check that was randomly inserted in the middle of the questionnaire, attractiveness measures (to ensure that the stimuli did not differ in terms of attractiveness), the manipulations checks of observability and type of material, and basic demographic questions. They were then thanked for their participation.

3.2. Measures

Purchase intention was measured with two items ($r = 0.88$) from (Mugge et al., 2017) (1 = strongly disagree; 7 = strongly agree; see Table B1 of Appendix B). The manipulation checks of the observability of the recycled content ($\alpha = 0.92$) and the attractiveness measures ($\alpha = 0.94$) were the same as in the pretest (see Table B1 of Appendix B). The manipulation check of the type of material (i.e., virgin vs. recycled plastic) was measured as the respondents’ estimate of the recycled plastic content of the illustrated bench as a percentage. One item “This is an attention check, please select the option ‘Strongly disagree’” acted as the attention check to prevent the inclusion of respondents who did not pay sufficient attention to the questionnaire.

3.3. Results and discussion

Manipulation and confounding checks. Six of the respondents were excluded from the analysis as they failed the attention check. One hundred fifty-six (53.2 % males, 46.2 % females, 0.6 % other, $M_{age} = 28.20$, $SD_{age} = 9.05$) responses were retained to test the hypotheses.

Even though the pretest results supported the success of our manipulations, both the manipulation checks of observability and the confounding checks were reassessed in the main study. The manipulation of observability of the recycled content (for the recycled plastic conditions) was successful. Respondents in the observable, recycled plastic condition rated the product as being significantly more observable ($M = 3.54$, $SD = 1.70$), compared with respondents in the non-observable, recycled plastic condition ($M = 2.47$, $SD = 1.36$), $t(75) = -3.03$, $p < 0.01$, $d = 0.70$.

In addition, manipulation checks showed that the manipulation of the type of material was successful. Respondents in the recycled plastic condition reported a significantly higher percentage of recycled plastic ($M = 77.12$, $SD = 17.89$) compared with respondents in the virgin plastic condition ($M = 62.28$, $SD = 32.24$), $F(1, 152) = 11.89$, $p = 0.001$, $\eta^2 = 0.07$. The main effect of observability ($p_{observab.} = 0.82$) and the interaction effect ($p_{interaction} = 0.21$) were found to be non-significant.

No significant main ($p_{observab.} = 0.35$; $p_{typeofmaterial} = 0.14$) or interaction ($p_{interaction} = 0.13$) effects were found for the attractiveness measure. Therefore, the attractiveness of the stimuli was similar across conditions, and attractiveness is not expected to influence the effects under investigation.

Hypothesis tests. An analysis of variance (ANOVA) with observability and type of material as independent variables and purchase intention as a dependent variable revealed a significant interaction effect on purchase intention, $F(1, 152) = 6.38$, $p < 0.05$, $\eta^2 = 0.04$. For the recycled plastic conditions, respondents seeing the observable product reported significantly higher measures of purchase intention ($M = 5.10$, $SD = 1.06$) than respondents seeing the non-observable product [$M = 4.26$, $SD = 1.65$, $t(75) = -2.67$, $p < 0.01$, $d = 0.61$], confirming H1.

However, respondents in the observable, virgin plastic condition did not report significantly higher measures ($M = 2.77$, $SD = 1.62$) of purchase intention, compared with respondents in the non-observable, virgin plastic condition [$M = 3.19$, $SD = 1.77$, $t(77) = 1.09$, $p = 0.28$] (see Fig. 3).

The main effect of the type of material on purchase intentions was

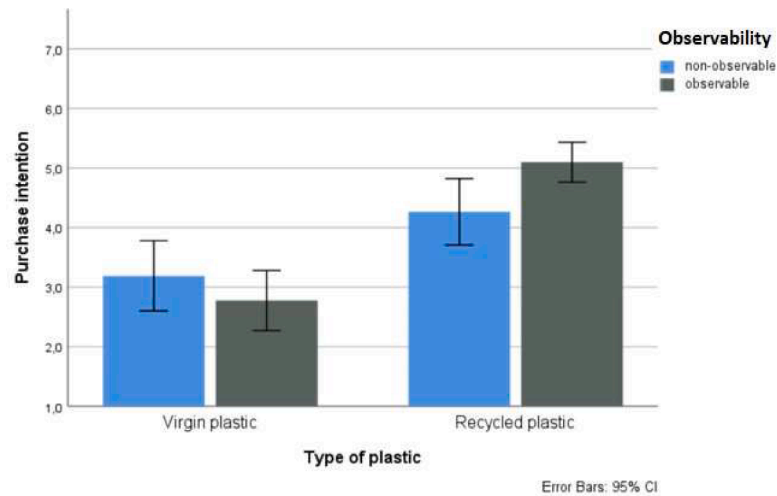


Fig. 3. The interaction effect of observability and type of plastic on purchase intentions for products made from recycled materials.

also significant, $F(1, 152) = 47.26$, $p < 0.001$, $\eta^2 = 0.24$, providing support for the notion that consumers tend to prefer products made from recycled materials more than their virgin counterparts. No main effect was found for the observability of the recycled content ($p = 0.40$), which is due to the virgin plastic conditions.

Overall, Study 1 shows that consumers have higher purchase intentions for products made from recycled materials with observable recycled content than for their non-observable counterparts, providing initial support for H1. Most importantly, the positive effect of observability on purchase intentions seems to be associated strictly with the recycled nature of the products through a semantic interpretation that brings associations of sustainability; hence it does not apply to virgin plastic products.

4. Study 2

Study 2 intends to replicate the supporting findings for H1 for a different product category. Furthermore, this study tests H2 on the role of identity signaling as a mediator for the effect of observability of the recycled content on purchase intentions for products made from recycled materials.

4.1. Method

4.1.1. Study design

This study employed a 2 (observability of the recycled content: non-observable vs. observable) \times 2 (product category: flowerpots vs. benches) between-subjects experimental design. Alongside benches, an extra product category was chosen to test our hypotheses. We chose flowerpots based on real-world examples of flowerpot manufacturers that sometimes use recycled plastic. Furthermore, observability of the recycled content is operationalised through a pattern that is different than the one used for the benches, improving the generalisability of our findings.

4.1.2. Development of the stimuli

A trained designer was hired to design the stimuli for the flowerpot conditions. The image of the non-observable condition illustrated a grey flowerpot with no observable elements. It was then altered to achieve the manipulation of observability of the recycled content, while minimizing variations in product aesthetics. The image of the observable condition was characterised by a dotted pattern inspired by real-world products (e.g., Gibson Karlo's Confetti flowerpot; Gibson Karlo, n.d.), creating associations with the recycled nature of the plastic.

Bench images for both conditions were similar as in Study 1. We

altered the image viewpoint in comparison to Study 1, for greater generalisability of the findings. The brand/company name was not included in any condition (Appendix D, Fig. D1).

4.1.3. Pretest

Stimuli were first pretested with a dedicated sample ($n = 79$) using the measures of observability of the recycled content and attractiveness used in Study 1. The pretest results demonstrated that respondents in the observable condition rated the product made from recycled materials as being significantly more observable ($M = 2.95$, $SD = 1.44$) compared to respondents in the non-observable condition ($M = 2.18$, $SD = 0.94$, $t(77) = 2.71$, $p < 0.01$). In terms of attractiveness, the observable condition ($M = 4.44$, $SD = 1.77$) did not significantly differ from the non-observable condition ($M = 4.71$, $SD = 1.41$, $t(77) = -0.71$, $p > 0.05$).

4.1.4. Respondents and procedure

A total of 219 (49.8 % males, 47.9 % females, 1.9 % other, $M_{age} = 27.86$, $SD_{age} = 7.90$) Prolific users from the Netherlands took part in the study. Respondents were randomly allocated to one of the four conditions. After reading a similar scenario as in Study 1, they were instructed to examine the image of the illustrated flowerpot/bench. Following the manipulation, respondents responded to measures of purchase intention and identity signaling. Respondents also answered to a novelty (i.e., atypicality) measure, intended to eliminate the alternative explanation that the novelty ((Mukherjee and Hoyer, 2001); Mugge & Dhal, 2013) of the recycled appearance explains the underlying mechanism of the effect of observability on purchase intention. Finally, participants responded to an attention check that was randomly placed in the middle of the questionnaire, attractiveness measures, the manipulation checks of observability of the recycled content, and basic demographic questions and were thanked for their participation.

4.2. Measures

The identity signaling measure consisted of three items (1 = strongly disagree; 7 = strongly agree) and was adapted from prior research ((Magnier et al., 2019); $\alpha = 0.92$). The novelty measure consisted of three items ($\alpha = 0.75$) of a semantic differential scale from (Mugge and Dahl, 2013). The other measures (purchase intention; $r = 0.88$, observability; $\alpha = 0.92$, attractiveness; $\alpha = 0.94$) and the attention check were the same as those of Study 1. All measures can be found in Table B1 of Appendix B.

4.3. Results and discussion

Manipulation and confounding checks. Fifteen respondents were excluded from the analysis because they failed the attention check. Two hundred four respondents (49.5 % males, 49 % females, 1.5 % other, $M_{age} = 27.77$, $SD_{age} = 7.81$) were retained to test the hypotheses. The manipulation check of the main study showed that the manipulation of the observability of the recycled content was successful, $F(1, 200) = 31.19$, $p < 0.001$, $\eta^2 = 0.14$. For benches, respondents in the observable condition rated the product made from recycled materials as being significantly more observable ($M = 3.99$, $SD = 1.78$), compared to the respondents in the non-observable condition [$M = 2.76$, $SD = 1.41$, $t(100) = -3.87$, $p < 0.001$]. For flowerpots, respondents in the observable condition rated the product made from recycled materials as being significantly more observable ($M = 3.27$, $SD = 1.78$), compared to the respondents in the non-observable condition [$M = 2.06$, $SD = 1.19$, $t(100) = -4.04$, $p < 0.001$]. The interaction effect of observability and product type on the manipulation check of observability was non-significant, $F(1, 200) = 0.03$, $p = 0.96$. Therefore, the subsequent effects under investigation are not expected to differ across product types.

No significant main ($p_{observab.} = 0.11$; $p_{productcat.} = 0.50$) or interaction ($p_{interaction} = 0.90$) effects were found for the attractiveness measure. Therefore, the attractiveness of the stimuli was similar across conditions, and attractiveness is not expected to influence the effects under investigation.

Common Method Bias. To mitigate Common Method Bias, we conducted an Exploratory Factor Analysis (EFA) for the mediator and dependent variable as per (Podsakoff et al., 2003), yielding two distinct factors that accounted for 87.2 % of the variance, significantly surpassing the expected variance from a single factor (65.5 %), thus affirming the robustness of our findings against common method bias concerns.

Hypothesis tests. An ANOVA with observability of the recycled content and product category as independent variables, and purchase intention as a dependent variable revealed a significant main effect of observability of the recycled content on purchase intention, $F(1, 200) = 21.88$, $p < 0.001$, $\eta^2 = 0.10$. Respondents seeing the observable product made from recycled materials reported significantly higher purchase intention for both benches and flowerpots ($M = 4.88$, $SD = 1.72$ for benches and $M = 5.65$, $SD = 1.40$ for flowerpots), compared to respondents seeing the non-observable product ($M = 4.13$, $SD = 1.44$, $t(100) = -2.37$, $p < 0.05$, $d = 0.47$ for benches and $M = 4.39$, $SD = 1.55$, $t(100) = -4.32$, $p < 0.001$, $d = 0.85$ for flowerpots; Fig. 4). Hence, we found additional support for H1.

A main effect of product category on purchase intention was also found. Respondents in the flowerpot conditions reported significantly

higher scores ($M = 5.00$, $SD = 1.60$) of purchase intention, compared to the respondents in the bench conditions ($M = 4.51$, $SD = 1.62$, $F(1, 200) = 5.74$, $p < 0.05$, $\eta^2 = 0.03$). The interaction effect of observability and product category on purchase intention was non-significant, $F(1, 200) = 1.47$, $p = 0.23$.

We tested H2 with the SPSS PROCESS Model 4 (Hayes, 2018), with 10,000 bootstrap analyses, by setting purchase intention as the dependent variable, observability of the recycled content as an independent categorical variable, and identity signaling as a mediator. Observability of the recycled content was found to have a significant positive effect on identity signaling ($b = 0.73$, $p < 0.01$). Identity signaling ($b = 0.43$, $p < 0.001$) was found to have a significant positive effect on purchase intention. The indirect effect of observability of the recycled content on purchase intention through identity signaling was significant and equal to 0.32, 95 % CI [0.1170, 0.5420]]. H2 was thus confirmed.

To rule out the alternative explanation that observable products made from recycled materials could be preferred more due to higher perceived novelty, we inspected the simultaneous mediating roles of novelty and identity signaling on the effect of observability on purchase intention. This was achieved with SPSS PROCESS Model 4 (Hayes, 2018) and 10,000 bootstrap analyses by setting purchase intention as the dependent variable, observability of the recycled content as an independent categorical variable, novelty and identity signaling as mediators. However, the confidence interval of the indirect effect of observability through novelty was non-significant, 95 % CI [-0.0144, 0.1942], while the indirect effect of observability through identity signaling was still significant, and equal to 0.17, 95 % CI [0.0643, 0.2922], thus excluding novelty as an alternative explanation for the proposed effects.

Overall, Study 2 replicates the findings of Study 1 (H1) for a different product category. It also provides initial evidence for the role of identity signaling as an underlying mechanism for the effect of observability of the recycled content on purchase intention (H2).

5. Study 3

Study 3 aims to further establish H1 and H2. It also investigates whether the effect of observability of the recycled content on identity signaling and on purchase intentions for products made from recycled materials is moderated by the privacy of the consumption context (i.e., low vs. high), pertaining to H3 and H4.

5.1. Method

5.1.1. Study design

This study employed a 2 (observability of the recycled content: non-

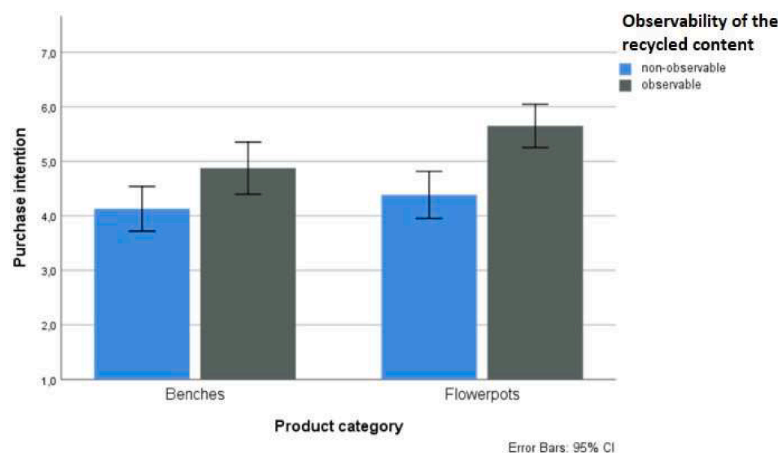


Fig. 4. The main effect of observability of the recycled content on purchase intentions for products made from recycled materials for benches and flowerpots.

observable vs. observable) \times 2 (privacy of consumption context: low vs. high) between-subjects experimental design. The product category chosen was flowerpots. We chose this product type because flowerpots are often placed and used both in lower-privacy settings (i.e., in one's living room) and in higher-privacy settings (i.e., in one's bedroom).

5.1.2. Development of the stimuli

With regards to the manipulation of observability, the stimuli were the same as the flowerpots used in Study 2. We created a scenario for the manipulation of the privacy of the consumption context. In the low-privacy conditions, respondents were invited to imagine that they wanted to buy a flowerpot for their living room, and that all their family and friends would see the flowerpot when visiting their house. In the high-privacy conditions, respondents were encouraged to imagine that they wanted to buy a flowerpot for their bedroom, and that no one else would be able to see the flowerpot, apart from them and perhaps their housemate(s). To ensure that respondents would imagine themselves in the situation described in the scenario, they were encouraged to think of how they could use the flowerpot in this setting and what it would mean for them to place the flowerpot in their bedroom (living room). The choice of a flowerpot as the focal product also strategically facilitated the manipulation of privacy. Hence, this product type allowed for a balanced examination of the interaction between the two independent variables, namely observability and privacy, demonstrating how they interplay within a domestic environment.

5.1.3. Respondents and procedure

A total of 320 (50.3 % males, 47.8 % females, 1.9 % other, $M_{age} = 29.77$, $SD_{age} = 9.35$) Prolific users from the Netherlands took part in the study. Respondents were randomly allocated to one of the four conditions. First, they read the scenario that manipulated the privacy of the consumption context. Afterwards, on the next page, respondents read about a specific flowerpot commercialised by a company (as in Study 2) and were instructed to examine the image of the illustrated flowerpot, displaying either a non-observable or an observable appearance. This step was intended for the manipulation of the observability of the recycled content. The flowerpot images developed in Study 2 were utilised in the present study (Appendix D; Fig. D1).

Following the manipulation, all respondents responded to measures of purchase intention and identity signaling. Respondents also responded to a question about whether they lived in a studio with only one room that serves as both living room and bedroom, intended to screen out the cases where the privacy of the consumption context would not be distinct. Finally, respondents responded to an attention check randomly placed in the middle of the questionnaire, attractiveness measures, the manipulation checks of observability of the recycled content and of the privacy of the consumption context, and basic demographic questions, and were thanked for their participation.

5.2. Measures

All measures were identical to those used in Study 2 (purchase intention; $r = 0.82$, identity signaling; $\alpha = 0.95$, manipulation check of observability of the recycled content; $\alpha = 0.89$, attractiveness; $\alpha = 0.94$). The manipulation check of the privacy of the consumption context consisted of two reverse scored seven-point items "Will you be using this flowerpot (bench) in the presence of friends and family?" and "To what degree will your display of the flowerpot (bench) be public?" (1 = not at all; 7 = very much) ($r = 0.88$) adapted from (White and Dahl, 2006). The attention check was the same as in Studies 1 and 2. All measures can be found in Table B1 of Appendix B.

5.3. Results and discussion

Manipulation and confounding checks. Sixteen respondents failed the attention check, and three respondents answered that they live in a

studio. These respondents were therefore excluded. Three hundred and one respondents (50.2 % males, 47.8 % females, 2 % other, $M_{age} = 29.52$, $SD_{age} = 9.27$) were retained to test the hypotheses. The manipulation of the privacy of the consumption context was successful. Respondents in the living room condition reported the consumption context as being a significantly lower-privacy context ($M = 3.56$, $SD = 1.63$) compared to respondents in the bedroom condition ($M = 5.06$, $SD = 1.18$), $F(1, 297) = 83.67$, $p < 0.001$, $\eta^2 = 0.22$. As intended, the main effect of observability of the recycled content ($p = 0.80$) and the interaction effect ($p = 0.60$) on the perceived privacy of the consumption context were non-significant.

Furthermore, the manipulation of observability of the recycled content was successful. Respondents in the observable conditions rated the product as being significantly more observable as being made of recycled content ($M = 2.80$, $SD = 1.49$) compared to respondents in the non-observable conditions ($M = 1.76$, $SD = 1.00$), $F(1, 297) = 50.07$, $p < 0.001$, $\eta^2 = 0.14$. As intended, the main effects of the privacy of the consumption context ($p = 0.51$) and the interaction effect ($p = 0.72$) on the observability of the recycled content were non-significant.

No significant main ($p_{observab.} = 0.25$; $p_{privacy} = 0.66$) or interaction ($p_{interaction} = 0.88$) effects were found for the attractiveness measure; therefore, attractiveness is not expected to influence the effects under investigation.

Common Method Bias. As in Study 2, we conducted an Exploratory Factor Analysis (EFA) for the mediator and dependent variable as per (Podsakoff et al., 2003), yielding two distinct factors that accounted for 89.6 % of the variance, significantly surpassing the expected variance from a single factor (74.3 %), thus reinforcing the validity of our findings against common method bias concerns.

Hypothesis tests. An ANOVA with observability of the recycled content and the privacy of the consumption context as independent variables, and purchase intention as a dependent variable revealed a significant main effect of observability on purchase intention, $F(1, 297) = 26.69$, $p < 0.001$, $\eta^2 = 0.08$. Respondents seeing the observable product reported significantly higher purchase intention ratings ($M = 5.00$, $SD = 1.49$) compared to respondents seeing the non-observable product ($M = 4.20$, $SD = 1.34$), providing additional support for H1.

Importantly, a significant interaction effect of observability of the recycled content and privacy of the consumption context on purchase intention was found, $F(1, 297) = 5.56$, $p < 0.05$, $\eta^2 = 0.02$. As shown in Fig. 5, respondents in the observable, low-privacy condition reported significantly higher measures ($M = 5.80$, $SD = 1.18$) of purchase intention, compared to respondents in the non-observable, low-privacy condition ($M = 4.71$, $SD = 1.34$), $t(143) = -5.22$, $p < 0.001$. Correspondingly, respondents in the observable, high-privacy condition also reported significantly higher measures ($M = 4.18$, $SD = 1.32$) of purchase intention, compared to respondents in the non-observable, high-privacy condition ($M = 3.77$, $SD = 1.20$), $t(154) = -2.03$, $p < 0.05$ (see Fig. 5). However, the effect of observability of the recycled content on purchase intention was found to be greater for the low-privacy conditions ($d = 0.86$), compared to the effect for the high-privacy conditions, supporting H4.

An ANOVA with observability of the recycled content and the privacy of the consumption context as independent variables, and identity signaling as a dependent variable, revealed a significant interaction effect on identity signaling, $F(1, 297) = 7.48$, $p < 0.01$, $\eta^2 = 0.03$. Respondents in the observable, low-privacy condition reported significantly higher measures ($M = 4.77$, $SD = 1.06$) of identity signaling, compared to respondents in the non-observable, low-privacy condition ($M = 3.41$, $SD = 1.43$), $t(143) = -6.58$, $p < 0.001$. Correspondingly, respondents in the observable, high-privacy condition also reported significantly higher measures ($M = 2.46$, $SD = 1.08$) of identity signaling, compared to respondents in the non-observable, high-privacy condition ($M = 1.79$, $SD = 0.85$), $t(154) = -4.278$, $p < 0.001$. However, the effect of observability on identity signaling was found to be greater for the low-privacy conditions ($d = 1.08$), compared to the effect for the

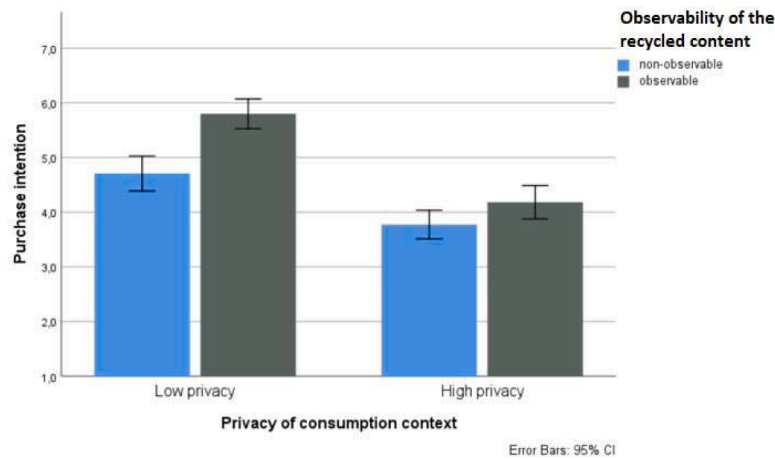


Fig. 5. The main and interaction effects of observability of the recycled content and the privacy of the consumption context on purchase intentions for products made from recycled materials.

high-privacy ($d = 0.69$) conditions, providing support for H3.

We tested H2 with the SPSS PROCESS Model 4 (Hayes, 2018), 10,000 bootstrap analyses, by setting purchase intention as the dependent variable, observability of the recycled content as an independent variable, and identity signaling as a mediator. Observability of the recycled content was found to have a significant positive effect on identity signaling ($b = 1.08, p < 0.001$). Identity signaling was found to have a significant positive effect on purchase intention ($b = 0.58, p < 0.001$). The indirect effect of observability of the recycled content on purchase intention through identity signaling was found equal to 0.63, 95 % CI [0.4117, 0.8629]. H2 was thus further established.

Additional analyses with the SPSS PROCESS Model 8 (Hayes, 2018) unveiled a significant moderated mediation for identity signaling (index of moderated mediation = -0.36 , 95 % CI [$-0.6696, -0.0885$]). The conditional indirect effect of observability of the recycled content on purchase intention through identity signaling was significant for high-privacy (0.34, 95 % CI [0.1747, 0.5255]) and low-privacy (0.70, 95 % CI [0.4342, 1.0135]) conditions, but the effect was larger for the latter. Identity signaling was thus found to mediate the effect of observability of the recycled content on purchase intention more strongly for low-privacy conditions.

Overall, Study 3 replicates the findings of the previous studies on the main effect of observability of the recycled content on purchase intentions (H1), and the mediating role of identity signaling (H2). Most importantly, Study 3 tests and confirms H3 and H4 regarding the moderating role of the privacy of the consumption context on the effect of observability on identity signaling and on purchase intentions.

6. General discussion

In an era characterized by environmental challenges and intensifying market competition, it is imperative for firms to prioritize the development of sustainable innovations that align with consumer preferences to retain and expand their customer base (Katsikeas et al., 2016; Paparoidamis et al., 2019). Gaining a comprehensive understanding of the ways that product appearance influences consumer adoption of products made from recycled materials is crucial for effective achieving market performance. In this context, three experimental studies were conducted to investigate the effect of observability of the recycled content on consumer purchase intentions for products made from recycled materials (RQ1), and to explain the underlying mechanism and boundary condition of this effect (RQ2).

Study 1 indicated that consumers have higher purchase intentions for observable products made from recycled materials compared to non-observable products. Observability of the recycled content thus seems to

be a meaningful trigger for the subsequent consumer responses; when the recycled nature of a product is implicitly communicated via observable patterns or textures in its appearance, the salience of product sustainability seems to increase for this product, leading to higher purchase intentions. Study 1 examined and confirmed that the effect of observability of the recycled content on purchase intentions is strictly associated, through semantic interpretation (Crilly et al., 2004), with the recycled nature of the products. Hence, we eliminated the alternative explanations that the effect of observability on purchase intentions can also hold for products made from virgin materials or that it was caused by the specific pattern.

To explore the underlying mechanism of the effect of observability of the recycled content on purchase intentions, Study 2 investigated and validated the mediating role of identity signaling. Observability of the recycled content seemed to trigger identity signaling by reflecting a positive image to others (Berger and Heath, 2007; Griskevicius et al., 2010), thereby leading to augmented purchase intentions. Furthermore, we eliminated the alternative explanation that novelty ((Mukherjee and Hoyer, 2001); Mugge & Dhal, 2013) of the recycled appearance explains the underlying mechanism.

Study 3 further replicated the main (H1) and indirect effect (H2) of observability of the recycled content on purchase intentions for products made from recycled materials. Importantly, Study 3 also demonstrated that the effect of observability on identity signaling (H3) and on purchase intention (H4) is stronger for low-privacy rather than high-privacy consumption contexts.

6.1. Theoretical implications

Many firms incrementally apply environmental sustainability strategies and green product development (Albino et al., 2009; Bouguerra et al., 2023). There is also increasing research focused on exploring how consumers respond to product appearance (Crilly et al., 2004; Maniatis, 2016; Mugge et al., 2018; Radford and Bloch, 2011), as is it a crucial strategic and tactical tool for firms (Luchs and Swan, 2011). Our research extends extant theoretical knowledge by a) introducing the concept of observability of the recycled content and examining its effect on consumer adoption of products made from recycled materials (RQ1), and b) revealing the underlying mechanism and boundary condition of the effect of observability of the recycled content on consumer purchase intentions (RQ2).

The current research findings respond to calls for further research on how strategies and practices pertaining to product design can serve sustainability (Luchs et al., 2016). In this regard, we build on prior research on the effect of product appearance on consumer responses,

drawing from the framework for consumer response to the visual domain in product design of (Crilly et al., 2004). Hence, we add to research on semantic interpretation and symbolic association (Crilly et al., 2004, 2009; Gonzalez et al., 2017; Mugge et al., 2018) in the context of sustainable products. We extend these lines of research by, first, highlighting that observable cues of recycled content in product appearance trigger semantic interpretations of the product's sustainable benefits, leading to higher adoption. Second, identity signaling was found to be a mediator explaining why consumers might prefer observable products over their non-observable counterparts. Observability of the recycled content can hence serve as a means of symbolic association (Creusen and Schoormans, 2005) and identity signaling (Berger and Heath, 2007). We add to previous literature unveiling that identity signaling to others can augment adoption of sustainable products (Griskevicius et al., 2010), since consumers may prefer these products due to their symbolic and reputational status benefits (White et al., 2019; Jaeger and van Vugt, 2022).

Third, in line with (Crilly et al., 2004), the social setting (i.e., privacy of the consumption context) was demonstrated to serve as a boundary condition in the effect of observability on identity signaling and purchase intentions for products made from recycled materials. Our findings confirm prior research highlighting that consumers are sensitive to identity signaling when their consumption behaviors are more observable in the immediate social setting of product consumption or possession (Crilly et al., 2004; Griskevicius et al., 2010).

Fourth, in exploring the effects of observability of the recycled content as a product appearance intervention, our study aligns with marketing and innovation scholars' calls for optimizing consumer responses to eco-innovations (Katsikeas et al., 2016; Papatoidamis et al., 2019; Varadarajan, 2017). Fifth, addressing calls for further research on consumer adoption of products made from recycled materials (Polyportis et al., 2022), the highlighted effects extend previous literature on how, apart from business interventions related to marketing elements, such as the availability of eco-labels (Wang et al., 2022), the intervention of the observability of the recycled content can also shape purchase intentions for products made from recycled materials. Sixth, by focusing on products made from recycled materials as a case of sustainable innovation (Bossle et al., 2016; Fernando et al., 2021; Papatoidamis et al., 2019), we contribute to research (Rogers, 2003) on how observability of innovations can augment their adoption.

6.2. Managerial implications

This research yields important and actionable implications for managers. There is an incremental need for businesses to reduce their use virgin materials and enhance their corporate environmental performance. At the same time, the use of recycled materials can help firms to meet consumer demand for more sustainable products. However, corporate processes for sustainable innovations are not only complex but also risky, as market uncertainties are often significant (Claudy et al., 2016; Juntunen et al., 2019; Watson et al., 2018). Moreover, prior research has revealed that sometimes recycled content cues can yield outcomes that are not consistently positive, but rather exhibit a range of effects, including negative ones (e.g., Acuti et al., 2022; Luchs et al., 2010; Meng and Leary, 2021).

In this context, product appearance can be used strategically to highlight the benefits of a sustainable product and communicate them to customers to potentially raise awareness of such benefits. Therefore, understanding the effects and underlying mechanisms of observability of the recycled content, as an intervention, on consumer adoption is crucial for firms seeking to tap into the growing demand for sustainable alternatives while aiming for business competitiveness.

The findings of this study can facilitate firms in their endeavour towards a more effective design of products made from recycled materials, thus enabling them to make informed choices that augment market appeal for such products. We demonstrate that consumers' semantic

interpretations based on observable cues of recycled content increase purchase intentions of products made from recycled materials. Managers have the unique opportunity to influence the appearance of products made from recycled materials, choosing between mimicking the appearance of virgin plastics or distinctly highlighting the recycled nature through observable cues like textures and patterns. Our research, which tested various patterns, indicates that making recycled content visible can significantly impact consumer perceptions and intentions. Accordingly, firms and marketers may consider implementing different patterns or textures on the appearance of the recycled product and investigating which of them are perceived by consumers as being observable – in other words, which patterns and textures can facilitate semantic interpretations of environmental benefits. This suggests that, along a set of guidelines provided by recent research (Polyportis et al., 2023), managers can enhance the market appeal of their products by strategically designing the appearance to emphasize sustainability through observable cues.

Furthermore, the strategy of leveraging identity signaling through product design can significantly boost pro-environmental consumer behavior. Interestingly, such strategy can be effectively achieved through product appearance, as the present research unveils. Beyond product appearance interventions, integrating marketing communications that highlight identity signaling, particularly for products used in public or semi-public settings, can amplify the effect. This dual approach—melding product appearance with targeted marketing communications—offers a potent mechanism for firms to not only align with environmental values but also to enhance consumer engagement and adoption of products made from recycled materials.

6.3. Limitations and future research

One limitation of the current research is that our experiments did not measure actual purchase behavior towards products made from recycled materials. However, we did measure behavioral intentions, which in comparison to attitudes have been shown to have a relatively strong relationship to behaviors (Fishbein and Ajzen, 1975). Future research can make use of choice experiments (Higgins et al., 2020) or auction approaches (Vecchio and Annunziata, 2015) to confirm the highlighted effects.

Moreover, while our experimental design isolated the effects of observability in a controlled environment and providing data triangulation across three studies with high internal validity, we recognize the limitations of this approach. Future research could replicate our finding using additional triangulation methods offering higher external validity, such as field experiments.

Furthermore, our study did not examine any brand effects (Hamzaoui-Essoussi and Linton, 2014). For example, if a brand is not renowned for its sustainability efforts, it would be worthwhile to investigate whether the observability of products made from recycled materials would be perceived positively in terms of corporate responsibility or as a method of greenwashing (Delmas and Burbano, 2011) with potential adverse effects on purchase intentions. Further research may investigate the influence of brands and brand concepts (e.g., brand warmth; (Janssen et al., 2022)) on consumer adoption of products made from recycled materials.

An additional topic for future research relates to the operationalization of observability of the recycled content. In our experimental studies, the observable patterns were relatively obvious on the benches and flowerpots. Yet, the manipulation checks of observability were not extreme, because at the same time we tried to avoid significant variations between the observable and non-observable conditions in terms of attractiveness. Attribute centrality – that is, the degree to which an attribute is integral in defining a product – is a crucial factor in perception and subsequent consumer evaluations (Gershoff and Frels, 2015). For instance, products with identical environmental benefits have been found to be perceived as more or less green, depending on

whether the benefit stems from a central versus a peripheral attribute (Gershoff and Frels, 2015). Future research may examine whether the examined effects hold for a stronger or more subtle (i.e., more or less central) operationalization of observability of the recycled content.

Our study effectively explored two different patterns conveying the observability of recycled content in product appearance. Future research should investigate how other potentially observable elements, such as colour and texture, may enhance the market appeal of recycled materials in products. Additionally, our research concentrated on categories that have already implemented recycled materials in practice. Expanding future studies to include a broader range of product categories can offer a more comprehensive understanding of consumer responses to observable (versus non-observable) products made from recycled materials across different categories.

The experimental studies of the present research examined the observability of the recycled content for products made from recycled plastics, which is considered an important type of recycled material. Future research may consider replicating the highlighted effects for other recycled material types, such as fibres or paper.

Addressing environmental challenges and meeting the increasing environmental concerns of consumers necessitates the development of sustainable products (Paparoidamis et al., 2019). To the extent that the observability of the recycled content exerts effects on consumer purchase intentions for products made from recycled materials, the theories and effects of the present research contribute to the theoretical foundations of understanding how to foster consumer adoption of such products, empowering firms to develop strategies for designing these products effectively.

CRedit authorship contribution statement

Athanasios Polyportis: Writing – review & editing, Writing –

Appendix A

Table A1

Summary of studies on consumer adoption of products made from recycled materials.

Authors and year of publication	Method	Dependent variable of consumer adoption	Main findings
Achabou and Dekhili (2013)	Quantitative	Behaviour/choice	Presence of recycled materials in luxury products reduces the preference of the product due to lower perceived quality.
Adigüzel and Donato (2021)	Quantitative	Purchase intention	Decreased purchase intention for luxury products made from recycled materials compared to their recycled counterparts, due to the enhanced novelty and pride.
Anstine (2000)	Quantitative	Willingness to pay	Willingness to pay for products made from recycled material is lower compared to that of products made from virgin materials.
Bae (2021)	Quantitative	Purchase intention	Entity theorists (who believe traits are fixed and unchangeable) have lower purchase intention for products made with recycled material than incremental theorists (i.e. who believe traits are malleable and can change).
Biswas et al. (2000)	Quantitative	Purchase behavior	Subjective norms, affect and past behavior predict purchase behavior for products made from recycled materials.
Calvo-Porrall and Lévy-Mangin (2020)	Quantitative	Purchase intention	Product image and product safety predict purchase intentions for products made from recycled materials.
Chaturvedi et al. (2020)	Quantitative	Purchase intention	Environmental concern, perceived value and personal norms predict purchase intention for products made from recycled materials.
De Marchi et al. (2020)	Quantitative	Behavior/choice	Within a specific product category (bottles), products made from recycled materials are preferred less compared to those made from virgin plastics.
Galati et al. (2022)	Quantitative	Purchase intention	Higher price leads to lower young consumers' purchase intention for products made from recycled materials.
Grasso et al. (2000)	Quantitative	Behavior/choice	For the same price, consumers choose products made from recycled textile compared those made from virgin materials. Patterns of purchase are varied by gender (higher adoption behavior for women).
Hamzaoui Essoussi and Linton (2010)	Quantitative	Willingness to pay, switching behavior	Perceived functional risk is an antecedent of the price that consumers are willing to pay. Consumers will switch from a product made from recycled materials to a new product within a smaller range of price for products with high functional risk.
Hamzaoui-Essoussi and Linton (2014)	Quantitative	Willingness to pay	The perceived quality of the recycled material influences willingness to pay for products made from recycled materials. Low-risk consumers are willing to pay a higher price than consumers who consider the risk of these purchases to be higher. Willingness to pay increases for high-risk respondents if brand is included.

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original draft, Visualization, Software, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Ruth Mugge:** Methodology, Investigation, Conceptualization, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing. **Lise Magnier:** Writing – review & editing, Validation, Conceptualization, Investigation, Methodology, Resources.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Table A1 (continued)

Authors and year of publication	Method	Dependent variable of consumer adoption	Main findings
Kamleitner et al. (2019)	Quantitative	Willingness to pay	Highlighting the past identity of the recycled product through storytelling techniques positively influences willingness to pay.
Kim and Choi (2005)	Quantitative	Behavior	Environmental concern and perceived consumer effectiveness influence purchase behavior for products made from recycled materials.
Kuah and Wang (2020)	Quantitative	Purchase intention, behavior	Non-significant relationship between purchase intentions and actual purchase behaviour of products made from recycled materials.
Luchs et al. (2010)	Quantitative	Behavior/choice	The positive effect of recycled content on consumer preference is reduced when strength-related attributes are valued more. This effect is attenuated when explicit cues about product strength are provided.
Luu and Baker (2021)	Quantitative	Purchase intention	Perceived quality, sustainability and safety predict purchase intention for products made from recycled materials.
Magnier and Gil-Pérez (2023)	Quantitative	Purchase intention	The ecological visual appearance of the package made from recycled materials predicted purchase intention. Purchase intention is more pronounced when there is a sustainability claim on the package. The findings vary as a function of environmental concern.
Magnier et al. (2019)	Quantitative	Purchase intention, willingness to pay	Anticipated conscience, value for money and perceived functionality predict purchase intention for products made from recycled materials. Anticipated conscience, recognisability and perceived safety are antecedents of willingness to pay a price premium.
Magnier and Gil-Pérez (2023)	Quantitative	Repurchase intention	Repurchase intention of products with single-use packaging made from recycled materials is lower than those with reusable packaging.
Mahmoodi and Heydari (2021)	Quantitative	Purchase intention	Discount and warranty offers increase purchase intention for products made from recycled materials.
Meng and Leary (2021)	Quantitative	Purchase intention, willingness to pay	Consumers perceive products made from recycled plastic as contaminated, reducing purchase intentions, especially among individuals with high disgust sensitivity. The phenomenon diminishes when the product does not come into direct contact with skin. Increased willingness to pay is demonstrated when the product is marketed with an appeal to attractive others.
Minton and Rose (1997)	Quantitative	Purchase intention	Environmental concern and norms predict purchase intention for products made from recycled materials.
Nguyen et al. (2020)	Quantitative	Purchase intention	Exposure through media and influencing power from the surrounding community augment purchase intention for products made from recycled materials.
Park and Lin (2020)	Quantitative	Purchase intention, behavior	Attitude-behaviour gap. Subjective norms, environmental concern, quality, and perceived consumer effectiveness predict purchase intention for products made from recycled materials. Quality, perceived consumer effectiveness and income are antecedents of purchase behavior.
Pretner et al. (2021)	Quantitative	Willingness to pay	Provision of environmental information raises willingness to pay, especially when that information is verified by a third party.
Queiroz et al. (2021)	Quantitative	Purchase intention	Product image and sustainability positively influence purchase intention. When quality or perceived safety were perceived to be lower, this led to decreased purchase intention.
Srinivasan and Blomquist (2009)	Qualitative	Willingness to pay	The presence of ecolabels leads to willingness to pay a positive price premium for products made from recycled materials.
Sun et al. (2018)	Quantitative	Purchase intention, behavior	Perceived quality and attitude to environmental protection are positively related to purchase intention for products made from recycled materials. Purchase intentions is a predictor of actual purchase.
Testa et al. (2021)	Quantitative	Purchase intention	Attractiveness, quality and eco-friendliness of the packaging positively influence purchase intention for products made from recycled materials.
Testa et al. (2022)	Quantitative	Purchase intention	Attitude towards the product and perceived product value, as a result of the presence of recycled materials, are antecedents of purchase intention for products made from recycled materials.
Wang et al. (2022)	Quantitative	Purchase intention	Availability of eco-labels, and existence of sustainable product attributes, such as traceable and recycled fabrics, augment purchase intention for products made from recycled materials.

Appendix B

Table B1
Constructs and items.

Constructs and items
Observability of the recycled content manipulation checks (Magnier et al., 2019)
The fact that the illustrated flowerpot (bench) is made of recycled plastic is apparent straight away.
Other people are able to observe that the illustrated flowerpot (bench) is made of recycled plastic.
The design of the illustrated flowerpot (bench) reflects that it is made of recycled plastic.
Purchase Intention (Mugge et al., 2017)
Given the information above, I am likely to purchase the illustrated flowerpot (bench).
Given the information above, I am willing to purchase the illustrated flowerpot (bench).
Identity signaling (Magnier et al., 2019)
Using the illustrated flowerpot (bench) reflects who I am.
Using the illustrated flowerpot (bench) would communicate who I am to other people.
By using the illustrated flowerpot (bench), I would make a better impression to other people.
Attractiveness (Bell et al., 1991)
Unattractive-Attractive
Bad appearance - Good appearance
Ugly - Beautiful
Novelty (Mugge and Dahl, 2013)
Old - Novel
Not original - Original
Not innovative - Innovative

(continued on next page)

Table B1 (continued)

Privacy of the consumption context manipulation checks (White & Dhal, 2006)
Will you be using this flowerpot (bench) in the presence of friends and family?
To what degree will your display of the flowerpot (bench) be public?
Attention check
This is an attention check, please select the option "Strongly disagree"

Appendix C



Fig. C1. Observable vs. non-observable benches in terms of their recycled content (Study 1).

Appendix D



Fig. D1. Observable vs. non-observable benches (Study 2) and flowerpots in terms of their recycled content (Studies 2 and 3).

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