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Marketing a new generation of bio-plastics products for a circular economy: The role of green self-identity, self-congruity, and perceived value

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ABSTRACT

Bioplastics represent an innovation for replacing materials obtained from fossil fuels and could provide significant benefits to the environment. A new generation of bioplastic from urban waste is now technically feasible. This paper is among the first to assume the perspective of the consumers rather than the manufacturers in addressing what could lead to the market acceptance of this particular type of bioplastic. A conceptual model is developed addressing psychological drivers that could encourage consumers' transition from a linear to a circular economy, with the purpose of better understanding what drives consumers' intentions to switch to and purchase products obtained from organic waste. Specifically, we find that green self-identity positively impacts perceived value, leading to higher behavioral intention. In addition, the relationship is moderated by self-congruity but not by differences in product involvement.

1. Introduction

In “The new plastic economy: rethinking the future of plastics”, the [Ellen MacArthur Foundation \(2017\)](#) warns that if the world does not change course, by 2050 there will be more plastic in the sea than fish. Undoubtedly, plastic plays an important role in everyday life as it is an affordable and versatile material. However, plastic is over 90% fossil fuel, and its lack of degradability poses serious environmental problems ([Banks, de Smet, & Linder, 2016](#)). Approximately 350 million tons of plastic are produced globally each year ([Statista, 2018](#)); of that, only 5% of the value of plastic packaging is retained in the economy, while 32% goes missing in the ecosystem. Only 2% of plastics are recycled into the same or similar quality (also called “closed loop”; [Neufeld, Stassen, Sheppard, & Gilman, 2016](#)). Even in the most advanced areas of the world, recycling figures are too low to be sustainable. For instance, each year approximately 31 million tons of plastic waste are generated in the US, of which only 6.8% is recycled ([Leblanc, 2017](#)). Similarly, the EU generates 26 million tons of plastic each year; less than 30% of the EU's plastic is recycled, and approximately 70% goes to landfills or incinerators ([European Commission, 2018](#)). Consequently, considerable attention is currently given to green technology innovation and related processes by governments, institutions, and academic research. For instance, greater plastic recycling will need adequate infrastructure capacity and innovation to process it ([European Commission, 2018](#)).

However, beyond focusing on the benefits from innovating and re-converting processes and products in a more environmentally friendly direction, firms should also put equal care in considering consumers' needs and evaluating how to successfully market products made of bioplastic ([Xie, Huo, & Zou, 2019](#)). Thus, the question for technicians and engineers is whether there are alternatives as inexpensive, light and versatile as plastic. Bioplastics are considered as a possible alternative to conventional plastics; a plastic is defined as a bioplastic if it is partly or entirely made from renewable raw materials but also if the plastic material meets standards for biodegradability ([Song, Murphy, Narayan, & Davies, 2009](#)). In this vein, technology is moving in the direction of bioplastics that, in contrast to traditional plastics, biodegrade in warm, humid conditions such as industrial composting and/or can be obtained from organic waste. Such waste also includes the organic components of municipal solid waste (e.g., from households and restaurants) ([Chen, Jiang, Yang, Yang, & Man, 2016](#)).

Instead, managers should answer a different question. Namely: what would consumers think of those alternatives? Would they buy products obtained from them?

Pressure to answer these questions has started from one of the poorest countries in the world, Bangladesh, which was the first country to ban certain kinds of plastic bags in 2002. China, usually considered one of the largest polluters globally, actually instituted a similar ban already in 2008. California was the first US state to enact a plastic bag

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ban in 2014, followed by Idaho, Arizona, and Missouri between 2015 and 2017 (Harvey, 2016). In 2017, the European Union decided to make all plastic packaging recyclable or reusable by 2030 (Gabbatis, 2018); lastly Italian law has banned plastic bags for fruit, vegetables and baked goods (Povoledo, 2018).

A consequence of the characteristics of bioplastics is that the products realized with them have the potential to move economies from a linear to a circular model for resource efficiency, as waste would re-enter the economy and become a valuable production resource. Successfully switching to bioplastics is of particular importance if one considers that half of the 300 million tons of solid waste annually produced by cities is composed of organic waste. This figure is expected to almost double by 2025 (Hoorweg & Bhada-Tata, 2012). Indeed, technicians, engineers, and biochemists have answered the challenge launched by the plastic bans and have developed polyhydroxyalkanoates-based (PHAs) bioplastics to transform urban waste (i.e., organic food waste from households and restaurants) into an environmentally friendly production material (Dietrich, Dumont, del Rio, & Orsat, 2016). Currently, PHAs are among the most promising biopolymers acting as a substitute for fossil fuel-based plastics because of several unique features (Mumtaz et al., 2010): full biodegradability under both aerobic and anaerobic conditions; comprising not a single polymer but a family of copolymers with largely tunable properties; the possibility to be microbially synthesized under mild process conditions; and the possibility to be obtained from a large range of waste feedstocks (Rodríguez-Perez, Serrano, Panti6n, & Alonso-Fari6nas, 2018).

Thus, the question regarding the technical feasibility of a new generation of bioplastics appears to have found an answer. However, the question regarding consumer acceptance of such green innovation is still unanswered as bioplastic products have not yet been marketed by companies, which are still focused on the production and technical aspects of these products.

A similar situation is found for the research debate related to bioplastic products. In fact, the majority, if not the totality, of studies on PHA-based bioplastics have dealt with technical production-related issues. To the best of the authors' knowledge, there has been little work on the consumer side (Russo, Confente, Scarpi, & Hazen, 2019), probably due to the absolute novelty of these plastics and the topic.

What drives consumers' acceptance of products made from bioplastic derived from organic waste? In addition, while consumers are today more sensitive to green issues than they were in the past (Zou & Chan, 2019), PHA-based biodegradable plastics and biopolymer products are obtained from organic solid and liquid waste from households and restaurants. Hence, a key aspect is whether customers' perceptions of the value of those products and the acknowledgment of their environmental impact overcome potential feelings of disgust from the raw materials. This has major implications for the intention to switch to and pay for bioplastic products and the successful marketing of those products, to turn them into pillars of a new circular economy. After all, for there to be a market for products made from organic waste, consumers have to be willing to buy and use them. Thus, one needs to understand whether consumers will accept them and what will help such acceptance to successfully exploit the positive environmental potential of PHA-based bioplastics.

Furthermore, the acceptance of PHA-based bioplastics holds an interest from the perspective of the consumers, as several recent studies have highlighted that, today, individuals are sensitive to products' environmental impact (see, e.g., Ertz, Karakas, & Sarig6llü, 2016; Zou & Chan, 2019), are concerned about the planet (e.g., Babutsidze & Chai, 2018; Felix, Hinsch, Rauschnabel, & Schlegelmilch, 2018), and could be willing to change habits to increase the environmental positiveness of their consumption (e.g., Biel, 2017; Notarnicola, Tassielli, Renzulli, Castellani, & Sala, 2017).

Accordingly, the present research investigates how consumers might respond to the introduction of products made of these innovative PHA-based bioplastics. This investigation has the potential to provide a

noteworthy contribution as in the current business environment, firms need to find new strategies to be greener "as green process innovation (...) can improve a firm's financial performance" (Xie et al., 2019, p. 1), while new technologies and technological efficiency need to be understood (Sgarbossa & Russo, 2017) by consumers to be successfully marketed. Indeed, past failures have shown that certain green practices are not well received by consumers, leading to relatively modest sales volumes despite their potentially positive environmental effects. For instance, Nike's line of environmentally friendly shoes, "Considered" (Jana, 2009), and Clorox's green line of cleaning products, "Green Works" (ERMA, 2018), were failures, and when car companies such as Honda, Volvo, and Toyota switched their motor wiring from traditional plastic to soy-based plastic, they withdrew their products from the market as consumers filed a class-action suit (Consumer Reports, 2018).

By adopting a managerial and marketing-related perspective from the eyes of the potential consumers, the present research investigates elements to successfully contribute to the shift from a linear to a circular economy by transforming waste back into a raw material suitable for replacing natural raw materials.

Based on the literature presented in Section 2, this paper identifies perceived value, green self-identity and self-congruity as potential drivers of consumer willingness to switch to and purchase bioplastic products. Specific hypotheses are developed that lead to the development of a theoretical model of moderated mediation for consumer acceptance of PHA-based products. Based on the measurements and the sample described in Section 3, the model is empirically tested in Section 4, and the results are discussed in Section 5, along with the theoretical and managerial implications. The study's limitations are presented in the final section, highlighting opportunities for future research.

2. Theoretical background and hypotheses

A circular economy has gained importance in literature as an extension of sustainability by addressing environmental implementation and providing useful business applications (Ghisellini, Cialani, & Ulgiati, 2016; Singh & Giacosa, 2019). There has been an increase in interest for a circular economy from both scholars and companies (Foundation, 2017; Geissdoerfer, Savaget, Bocken, & Hultink, 2017). In this vein, green product innovation has been recognized as a key factor for growth and environmental sustainability (Xie et al., 2019). In addition, investing in green product innovation can help prevent companies from facing environmental protests and legal penalties while also allowing them to develop new potential market opportunities and achieve unforeseen success through the successful commercialization of green products (Papadas, Avlonitis, Carrigan, & Piha, 2018;), as well as improving companies' positive image, brand acceptance and financial performance (e.g., Cho & Baskin, 2018). In this vein, bio-based products are at least partially made from renewable materials such as wood, grasses, and crops (Reinders, Onwezen, & Meeusen, 2017). Within this context, bioplastic products can be described as a green innovation as they are biodegradable or even compostable under the right conditions and have the potential to become a feasible alternative to fossil fuel-based plastics that are nonrecyclable resources (Jenkins, Majano, & Gutiérrez, 2016; Russo et al., 2019).

While recycled, refurbished and remanufactured products represent an increasingly researched phenomenon in the circular-economy literature (e.g., Hazen, Boone, Wang, & Khor, 2017a; Liu, Lei, Huang, & Leong, 2018; Mugge, Jockin, & Bocken, 2017), not much is known about consumers' acceptance of bio-based products (Reinders et al., 2017). Thus, to build a theoretical framework for the understanding of consumer reactions toward bioplastics the literature on green products appears to be best suited to draw from. Accordingly, this paper refers to existing research about green products. In this vein, green self-identity commonly refers to how consumers describe themselves (Cook, Kerr, & Moore, 2002) in terms of personal motivations, social interactions, and expectations about relevant others (Ellemers, Spears, & Doosje, 2002).

Green self-identity is useful to both differentiate oneself from others and to adhere to the values and behaviors of the group of people to which an individual wants to or feels like they do belong (van Gils & Horton, 2019). In general, the link among green self-identity, perceived value, and environmentally friendly attitudes and behaviors established by previous studies can be more generally envisioned within the theoretical frame of the consistency between attitudes and behaviors (Kalafatis, Pollard, East, & Tsogas, 1999) or self-congruity (Sirgy, 1985). This is in line with the concept of self-congruity under which consumers evaluate self-congruity with a product class and/or brand stimulus by retrieving personality associations from memory to compare with their self-concept (Sirgy, 1985). Hence, if consumers perceive a good match between the brand/product and themselves, such match would lead to more favorable attitudes and behaviors toward that brand/product (Aguirre-Rodríguez, Bosnjak, & Sirgy, 2012).

2.1. From green self-identity to perceived value for bioplastic products

Value creation is a central concept in the management, organization and marketing literature, both at the micro level (individual, group) and the macro level (organizational theory, strategic management) (Lepak, Smith, & Taylor, 2007). Perceived value can be defined as a set of attributes related to the consumers' perceptions of a product's value (Ashton, Scott, Solnet, & Breakey, 2010). In turn, value can be defined as a trade-off between benefits and sacrifices, where the customers interact with a particular good (Payne & Holt, 2001). Previous research has identified value as a driver of consumer behavior that operates as a criterion for defining preference and making evaluations (Kumar & Noble, 2016; Kumar & Reinartz, 2016). However, "values" differ from value as they are personal convictions individuals hold with respect to themselves and the goals they strive toward (Sánchez-Fernández & Iniesta-Bonillo, 2007). From this perspective, values can represent an antecedent of individuals' preference judgments and help further specify what the "value" is for an individual (Kumar & Noble, 2016; Sánchez-Fernández & Iniesta-Bonillo, 2007). Among the different consumer values identified by previous studies, self-identity has achieved a leading role for theory and practice (Johe & Bhullar, 2016). Self-identity can be defined as the way an individual sees himself/herself and how (s)he decides to adhere to the values and behaviors of the group of people to which (s)he wants to or feels like (s)he does belong (Whitmarsh & O'Neill, 2010). In this vein, self-identity can be envisioned as a key constituent of the preference judgment and value-building process of an individual (Dermody, Koenig-Lewis, Zhao, & Hanmer-Lloyd, 2018).

Self-identity has been long investigated in other contexts, such as in tourism (Ourachmone, 2016), but only recently in the domain of environmental issues (Dermody et al., 2018). Within the domain of environmental or "green" issues, due to its growing importance and specificity, there is a general consensus that self-identity takes the form and name of *green self-identity* (Barbarossa, de Pelsmacker, & Moons, 2017; Chen & Chang, 2012; Khare, 2015; Whitmarsh & O'Neill, 2010), referring to "a consumer's overall appraisal of the net benefit of a product or service between what is received and what is given based on the consumer's environmental desires, sustainable expectations, and green needs" (Chen & Chang, 2012, p. 505).

The combined evidence from these studies suggests that the perceived value from green products could be influenced by a consumer's value system—specifically from the degree to which consumers self-identify as green people. The present research posits that green self-identity could play a key role in enhancing the value that consumers perceive from environmentally friendly products. Accordingly:

H1: *Higher levels of green self-identity lead to a higher perceived value for bioplastic products.*

2.2. From perceived value to behavioral intentions

Considerable support exists for the impact of perceived value on environmental-related behaviors, such as the purchase of green products (Gonçalves, Lourenço, & Silva, 2016). Based on the theory of consumption values (Sheth, Newman, & Gross, 1991), different facets of perceived value can be identified that may influence behaviors (Papadas et al., 2018; Sweeney & Soutar, 2001) related to consumers' perceptions of green products, their proper functioning, and the benefits they provide. In fact, based on this theory, consumer choice is a function of multiple consumption values, namely, functional, conditional, social, emotional and epistemic value, and the decision making may be influenced by any or all of the five consumption values (for a review, see Sheth et al., 1991).

Results from previous studies that adopted the theory of consumption values found mixed evidence about the separate effect of specific facets of value. For instance, Lin and Huang (2012) suggested that the emotional, conditional and epistemic value perceived for green products are the main influencers of consumers' preferences for green products over traditional ones. Conversely, Khan and Mohsin (2017) suggested that functional, social, and environmental value have the most positive effects on consumers' behaviors toward green products.

Despite disagreement as to the exact role and number of value facets, there is general agreement that the overall construct of perceived value can affect the adoption of green products (e.g., Chen, 2013; Chen & Chang, 2012; Gonçalves et al., 2016; Tseng & Hung, 2013). Similarly, in domains other than, but akin to, green marketing, perceived value has been recently found to be a primary antecedent to behavioral intentions, such as the purchasing of recycled and upcycled products (Park & Lin, 2018). However, there is no previous research relating value to behavior in the context of bioplastic products, due to their novelty. Nevertheless, although there are striking differences between generic green products and bioplastic products, by analogy, this paper extrapolates evidence from generic green products to hypothesize a similarly positive link between value and behavior.

Since some companies promote their products by means of deceptive claims about their environmental value, customers are averse to purchasing their products (Kalafatis et al., 1999). Consequently, poor perceived value can result in the loss of consumer purchase intention (Sweeney & Soutar, 2001). Hence, green perceived value currently plays a more important role in the environmental era. With the rise of environmentalism currently, green perceived value is crucial to green purchase intention, so this paper poses the following hypothesis:

H2: *The perceived value from bioplastic products has a positive effect on the intention to purchase bioplastic products (H2a) and to switch to them (H2b).*

The intention to switch refers to exiting a relationship (Keaveney, 1995), meaning – in our case – to replace a fuel-plastic product that a consumer already owns with an equivalent bioplastic product. Instead, purchase intention refers to buying ex-novo a product, and choosing to buy one made of bioplastic. That is, the purchase (repurchase) is establishing (or maintaining) a status quo, while switching represents breaking it (Inman & Zeelenberg, 2002).

2.3. The role of self-congruity with green products

The concept of self-congruity generally concerns an assessment of the match or mismatch between consumers' perceptions of a brand/product and themselves (Sirgy, 1985). A match leads to more favorable attitudes and behaviors toward a brand/product (Aguirre-Rodríguez et al., 2012), as widely documented, for instance, in food (Shamah, Mason, Moretti, & Raggiotto, 2018) or cosmetics (Khalid, Wel, Mokhtaruddin, & Alam, 2018).

Existing research consistently acknowledges that self-congruity

affects how consumers relate to and behave toward products. However, evidence from previous studies seems to support more of an indirect than a direct relationship between self-congruity and behavior regarding green products. For instance, Shamah et al. (2018) found that self-congruity enhances brand loyalty. In contrast, Jena and Sarmah (2015) found no direct relationship between self-congruity and behaviors such as recycling.

Those studies investigated the role of congruity between the self-image of an individual and the image of an object, then established a link with a behavior directed toward that same object. The “object” of those studies was usually a well-known (green) product or brand. However, green products and bioplastic products are not the same, though the latter belong to the former. As highlighted in the introduction, bioplastic products are a new and specific kind of green product that is still in a phase of early mass commercialization. Thus, in the present research, the “object” whose congruence with the self is assessed by the individual cannot be the same object of the behavior. That is, the present research addresses the relationship between self-congruity related to green products and behavior related to bioplastic products. This asymmetry further strengthens the logic underpinning the prediction of an indirect rather than a direct role for self-congruity. Specifically, translating the findings and considerations of previous literature about self-congruity to the specific context of the present analysis, the authors posit that when consumers perceive high congruity between themselves and green products, it helps to tighten the relationship between green self-identity and the perceived value for bioplastic products. The process of building or strengthening perceived value for bioplastic products should be facilitated when consumers already feel more connected to the broader family of green products. More formally:

H3: Self-congruity with green products moderates the relationship between green self-identity and perceived value for bioplastic products, with higher self-congruity leading to higher perceived value.

2.4. From green self-identity to behavioral intentions

Previous research in green marketing has identified other relevant determinants of behavior specific to the adoption of green products, highlighting how green self-identity can lead to green conduct (e.g., Sparks & Shepherd, 1992). Indeed, previous research has identified self-identity as a significant predictor of several “green” actions (Barbarossa & de Pelsmacker, 2016). For instance, recycling behaviors are driven by consumers’ feelings of being recyclers (Mannetti, Pierro, & Livi, 2004). The same can be said for the intention to buy eco-products, which has been found to be affected by individuals’ perceptions of being green (Sparks & Shepherd, 1992).

In line with those findings, Whitmarsh and O’Neill (2010) identified a “behavior-specific level” of green self-identity related to the purchase intention of green products. Similarly, Barbarossa and de Pelsmacker (2016) recently advanced green self-identity as a self-centered antecedent of purchase intention for eco-friendly products and, more generally, as a driver of environmentally friendly behaviors. Hence, we hypothesize a direct positive link between green self-identity and behavioral intentions toward bioplastic products. More specifically:

H4: Green self-identity leads to a higher intention to purchase bioplastic products (H4a) and to switch to them (H4b).

2.5. The theoretical model

Overall, the hypotheses link the literature on green self-identity, value, and self-congruity to green products with behavioral intentions toward the new category of bioplastic products. Self-congruity theory (Sirgy, 1985) and the theory of consumption values (Sheth et al., 1991) translated into the context of green and bioplastic products allow us to

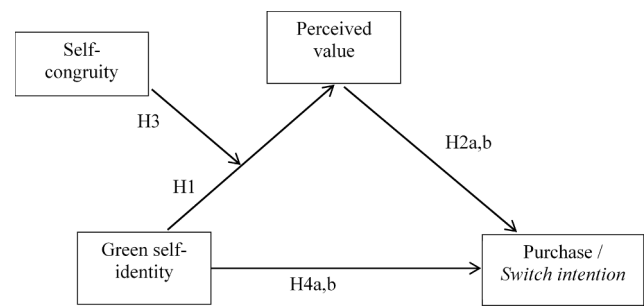


Fig. 1. The theoretical model.

envision consumer behaviors regarding bioplastic products as influenced by factors related to the consumer’s self-image, how that image fits with green products, and the value. Thus, those theories provide a psychology-based explanation of the potential determinants of individuals’ reactions toward bioplastic products. Using the insights from these theories to better understand consumers’ purchase intentions and the switching to bioplastic products, this paper posits the following influencing factors on consumer behavior: green self-identity, self-congruity, and perceived value.

Specifically, this paper hypothesizes that when consumers perceive stronger feelings of green self-identity, they will perceive positive value from bioplastic products (this will particularly be the case when they already feel high self-congruity with more generic green products) and, in turn, develop a higher intention to purchase bioplastic products or switch to them in the future. In summary, the present research develops a moderated mediation model where perceived value mediates the relationship between green self-identity and purchase/switch intention, with self-congruity moderating the relationship between green self-identity and perceived value. Fig. 1 presents the proposed relationships.

As can be observed in Fig. 1, the left side of the model represents the perceptions of the individual and her/his psychological dimensions and drivers. The right side of the model represents economically relevant actions, the potential gain for bioplastic products, and potential sources of revenue. The proposed hinge between the two sides is the value perceived by consumers from the bioplastic products.

In summary, the present research aims at assessing from a marketing-based perspective how consumers’ green self-identity can translate into perceived value for bioplastic products and help consumers develop positive intentions of switching to and paying for those products.

3. Research method

3.1. Sample and measurements

The United States is the largest producer of food waste in the world (Chandelier, 2016). In addition, they are the first Western country to adopt a plastic ban on a state-wide scale (California, Arizona, Michigan, Idaho, and Missouri). Thus, a US sample was recruited from a panel by Toluna, a leading provider of on-demand consumer insights with a community of over 14 million consumers in 68 countries. A short explanation about bio-generated PHA material was read to 300 US respondents (the use of a timer ensured they could not skip the text without reading it), then they saw a chair made from bioplastic material.

To select the product to be evaluated, a focus group conducted by the authors with 10 experts, both managers and researchers in the production of bioplastics confirmed that chairs were one of the most likely applications. In fact, they argued that chairs are one of the most likely products to be produced using bio-based PHA material due to several reasons.

In addition to being well-known to the general public and not

subject to particular cross-cultural issues or health risks, chairs were chosen because green and/or recycled components are commonly used in their production (Waste Recycling, 2018), such as bio-based polyurethane foams for upholstery (Bio-based Polyurethane Industry Report, 2015, 2020).

After such decision, a pretest on perceived realism conducted among a sample of 50 respondents was conducted (Mean_{realism} \geq 6.04 on a 7-point scale). The short explanation about PHA was pretested for clarity (Mean_{clarity} \geq 6.11 on a 7-point scale).

Respondents were asked about perceived value (adapted from Chen & Chang, 2012; four items), self-congruity (adapted from Mazodier & Merunka, 2012; three items), green self-identity (adapted from Barbarossa & de Pelsmacker, 2016; four items), purchase intention (adapted from Yoo & Donthu, 2001; two items), and switching intention to the bioplastic product (adapted from Hazen, Mollenkopf, & Wang, 2017b; three items). All items could be ranked from 1 to 7. Finally, respondents were asked about standard demographics (age, gender, education, income, and location). An attention check was included, leading to a final usable sample of 292 respondents (mean age = 53, median age = 54; 45% female). Details about the measurements are reported in Appendix A.

3.2. Moderated mediation model

A moderated mediation analysis was run to test the theoretical model advanced in Fig. 1 using the PROCESS macro for SPSS with the mean composite scores on the items for each construct (Hayes, 2018). Self-congruity was put as a moderator of the relationship between green self-identity and perceived value, which was put as a mediator of the relationship between green self-identity and the intention to purchase/switch to bioplastic products. The intention to purchase/switch was the dependent variable (see Fig. 2). Thus, two models were run: one for purchase intention and one for switching intention as the dependent variable. The analyses assessed (1) the effects of green self-identity on the intention to purchase/switch (both directly and indirectly, through perceived value), (2) the effect of green self-identity on perceived value (as moderated by self-congruity), and (3) the effect of perceived value on the intention to purchase/switch.

Given the peculiarity of these particular bioplastic products, the potential relevance of product attractiveness as a control variable was accounted for in the model by treating it as a covariate.

The analysis combines mediation and moderation to estimate the conditional indirect effect of green self-identity on purchase/switching intention through perceived value as moderated by self-congruity (Model 7 by Hayes, 2018; see Fig. 2). The statistical significance of the direct and indirect effects was evaluated by means of 10,000 bootstrap samples to create bias-corrected confidence intervals (Cis: 95%) with heteroscedasticity-consistent SEs (Hayes, 2018).

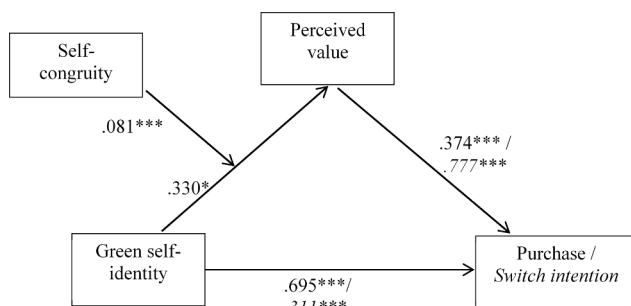


Fig. 2. The multiple moderated mediation analysis (model 7 by Hayes, 2018). Int = Interaction; * $p < .05$; *** $p < .001$.

4. Results

4.1. Scales and measurements

In line with the procedures by Anderson and Gerbing (1988) and MacKenzie, Podsakoff, and Podsakoff (2011) to ensure the adequacy of measurements, a confirmatory factor analysis shows that all factor loadings exceed the recommended 0.6 threshold, while the composite reliability (CR) and average variance extracted (AVE) exceed the recommended 0.7 and 0.5 thresholds, respectively (Fornell & Larcker, 1981; Voorhees, Brady, Calantone, & Ramirez, 2016). The minimum CR is 0.76 and the minimum AVE is 0.62, exceeding the highest squared correlation between any two variables, thus ensuring discriminant validity (Voorhees et al., 2016). Cronbach alphas range between 0.92 and 0.96. Thus, the measurement model is adequate. Details are provided in Appendix A.

4.2. Moderated mediation

Green self-identity leads to higher value perceptions from bioplastic products (effect = 0.330; $p = .031$), providing support for hypothesis H1.

In line with hypothesis H2, perceived value from bioplastic products is positively related to consumers' intentions to purchase (effect = 0.374; $p < .001$; H2a) and to switch to them (effect = 0.777; $p < .001$; H2b).

As advanced in hypothesis H3, self-congruity significantly and positively moderated the effect of green self-identity on value (effect = 0.081; $p = .001$) and, specifically, the relationship between green self-identity and value was stronger when individuals displayed higher self-congruity with green products (Effect_{high} = 0.694 vs. Effect_{low} = 0.505), as hypothesized in H3. Finally, a significant direct effect emerged for green self-identity on the intention to purchase (effect = 0.695; $p < .001$; H4a) and to switch to bioplastic products (effect = 0.311; $p < .001$; H4b), in line with hypothesis H4. Overall, this evidence supports the perceived value as a partial mediator of the relationship between green self-identity and behavioral intentions and supports self-congruity as a moderator of the relationship between green self-identity and perceived value.

The results suggest that individuals who display higher green self-identity perceive higher value from bioplastic products, especially when self-congruity with green products is high. Both perceived value and green self-identity lead to higher behavioral intentions.

The results of the PROCESS macro are illustrated in Fig. 2 and summarized in Tables 1 and 2.

4.3. Summary of the results

Hypotheses H1, H2, H3, and H4 are supported. This paper investigated what drives individuals to buy and switch to bioplastic products, addressing their green self-identity, the value perceived from the bioplastic product, and self-congruity with green products. The results showed that all these variables play a role in driving behavioral intentions. Nonetheless, self-congruity does not have a direct effect on consumer intentions. Rather, value and green self-identity affect behavioral intentions. Further, higher perceived value from the bioplastic product is triggered by higher green self-identity (especially when self-congruity is high) and positively affects intentions.

5. Discussion

5.1. Theoretical implications

This paper introduces relevant implications to scholars and managers interested in the exploration of elements for successfully understanding consumers' acceptance of the innovation that products made

Table 1
Moderated-moderated mediation analysis.

	coeff	se	t	p	LLCI	ULCI
Green self-identity on perceived value	0.330	0.152	2.165	0.031	0.030	0.630
Self-congruity on perceived value	-0.079	0.096	-0.823	0.411	-0.267	0.110
Moderation of self-congruity	0.081	0.024	3.385	0.001	0.034	0.127
Perceived value on purchase intention	0.374	0.069	5.400	0.000	0.238	0.510
Perceived value on switching intention	0.777	0.052	14.995	0.000	0.675	0.879
Green self-identity on purchase intention	0.695	0.082	8.504	0.000	0.534	0.856
Green self-identity on switching intention	0.311	0.061	5.090	0.000	0.191	0.432
Direct effect on purchase intention	0.695	0.082	8.504	0.000	0.534	0.856
Direct effect on switching intention	0.311	0.061	5.090	0.000	0.191	0.432

LLCI = lower limit confidence interval; ULCI = upper limit confidence interval.

Table 2
Moderator analysis: conditional effect of green self-identity on perceived value at values of the moderator (Self-congruity with green products).

Self-congruity	Effect	se	LLCI	ULCI
low	0.505	0.090	0.343	0.699
medium	0.606	0.066	0.489	0.749
high	0.694	0.067	0.573	0.83

LLCI = lower limit confidence interval; ULCI = upper limit confidence interval.

from urban food waste. Implications are relevant also to policy makers as bioplastics offer a unique opportunity to begin the replace fossil fuel raw materials and, therefore, shift from a linear to a circular economy.

The present analysis provides a shift of focus from how to physically engineer bioplastics with the right chemical procedures to how to increase consumer acceptance of bioplastic products integrating them into a circular economy. The present research makes a first contribution by integrating consumers into the issue of bioplastics on a marketing- and management-based theoretical basis, providing an opportunity for scholars from marketing and strategic management disciplines to tell their side of the story. Specifically, this research addresses the role of perceived value, green self-identity, and self-congruity as potential drivers of consumer willingness to purchase and switch to PHA-based bioplastics. The previous literature advanced a set of potentially relevant variables, but these relate to more “traditional” green products, while little is known about consumer perceptions of PHA-based bioplastics due to their novelty and difference from “traditional” green products.

From the technical point of view of manufacturing, the new bioplastic products can take the place of actual fossil fuel-based plastics that produce tons of waste with incremental problems for the environment. However, to successfully exploit the market potential of such innovation it is important to understand how consumers perceive products made from bioplastics. Due to the novelty of these products, the analysis was based on the literature on remanufactured products that might be relatively close in their underlying logic. For remanufactured products, the literature has shown that consumers perceive a difference compared with new products, which affects purchase and switching intentions (Wang, Huscroft, Hazen, & Zhang, 2018).

Thus, the second contribution of the current research is to develop a conceptual model for bioplastic products from the literature on more “traditional” green products and to test the model empirically. The results show that the high value perceived from bioplastic products leads to higher purchase and switching intentions and, in turn, the value is driven by consumers’ green self-identity, especially if the consumer feels a high congruence between himself/herself and the product. The results show that consumers would be willing to accept bioplastic products if the products’ value and potential positive effect on the environment were made clear, and if the fit between these products’ features and consumers’ personal values was also highlighted. Furthermore, there is value in the distinction between purchase and

switching intention, as they are differently affected by the independent variables. Specifically, replacing the old (fuel-plastic) with the new (bioplastic) products is more due green self-identity. Instead, choosing bio- over fuel-plastic products when purchasing *ex novo* is more due to the perceived product performance of the green alternative. This highlights a self-identity-centered choice process for switching, and a product-centered process for purchase, in line with previous literature that linked switching behaviors and self-identity in domains other than green products (e.g., Antón, Camarero, & Rodríguez, 2013; Lam, Ahearne, Hu, & Schillewaert, 2010).

The third contribution stems from the inclusion of the theory of consumption values that allowed for the identification of perceived value as the main driver of consumer intention to purchase bioplastic products and to switch to them. This is helpful for marketing and management scholars to actively take part in the circular economy debate, including consumers and their perceptions upon a theoretical basis.

Fourth, the conceptual model developed in the present research constitutes an enrichment in that it applies considerations from the literature on value integrated with self-congruity theory to the domain of bioplastic products. This allows consumers to be included when discussing the circular economy, with specific attention given to matters of consumer psychology. The present research no longer addresses the consumer as a passive, indistinct participant, but rather as a unique individual whose acceptance of bioplastic products is guided by a psychological assessment of self-identity.

5.2. Managerial implications

From a managerial point of view, this paper suggests the importance of perceived value as a trigger to switch from fossil fuel-plastic to bioplastic products. Thus, perceived value should be communicated in the marketing strategy for bioplastic products, especially as bioplastics are still more expensive to make than fossil fuel-based plastics (partly due to smaller economies of scale). Consumers need to know about these products and be willing to pay more for them, acknowledging their potential for the environment. To successfully activate a circular economy, it will be necessary to embark on customer education strategy campaigns that provide information about the importance of such products and their usage. Companies could use social marketing activities to help develop and modify attitudes, intentions, and awareness.

Overall, the findings suggest that consumers have to be involved in and made aware of the value of these products, specifically in relation to their own personal values and how they see themselves. It is through such co-value projects that companies could obtain profits from investing in or switching to PHA-based bioplastic products. Given that bioplastics would allow a reduction in plastic waste as well as enhance food waste collection and recovery, firms could enjoy a truly circular economy. Further, avoiding tons of food waste being sent to landfills and incinerators is not only profitable but an urgent social challenge for governments, stakeholders, and responsible companies. In this context,

the EU has recently promulgated four pioneering directives known as the Circular Economy Package; by the end of 2023, EU countries will be obliged to separate biowaste in addition to the separate collection that already exists for paper and cardboard, glass, metals, and plastic. Moreover, the European Parliament approved a new law banning single-use plastic items such as plates, cutlery, straws and cotton bud sticks (News European Parliament, 2019). These directives provide further evidence of the potential of food waste either as a serious cost (in a linear economy) or as a prized resource for PHA bioplastics (in a circular economy). This should be particularly relevant for US firms and consumers, as the US tops the world in food waste (Chandelier, 2016). Such directives also exemplify the urgency of addressing bio products in academic literature to help practitioners understand what can drive their successful acceptance by consumers.

Bioplastics should be a feasible alternative to fuel plastics, but even the most advanced countries are far from closing the plastic loop, and more investments in green innovations are needed (Eriksen, Damgaard, Boldrin, & Astrup, 2019). While it might be difficult to see in the near future bioplastic water bottles substituting PET, for example, which is the only valuable plastic recycled today (Russo et al., 2019), our results encourage companies to concentrate their efforts on bioplastics as consumers appear to answer positively.

6. Limitations and future research

This paper is not meant to be conclusive. Rather, it brings attention to the need to address bioplastic products not only from the perspective of manufacturers but also from the perspective of consumers. Several limitations highlight useful directions for future research. First, this paper focuses on consumers' perceptions of a furniture item. Future research can expand the focus to other products, for example, computer cases, shopping bags, toys, packaging and boxes to transport goods, thus increasing the generalizability and the business impact of the findings from this paper.

Second, recycling and waste management practices vary greatly among Europe, North America, and Asia. The findings from this paper concern North Americans and show a consistent pattern. Nonetheless, European, South American, African, and Asian consumers may have

different cultural sensibilities. Therefore, future research could increase the generalizability of the present findings by addressing consumers from different regions.

Third, this paper does not take into account how to communicate to consumers the importance and potential value of bioplastic products. Future research could focus on customer education research, how to communicate the value of buying bioplastic products, and how to emphasize the fit with consumers' images of themselves.

Fourth, the increased awareness of sustainability issues has increased the number of consumers following lifestyles oriented toward ethical consumption. In this vein, a recent investigation found that nearly one-half of vegan consumers became vegan for environmental-related motives (Janssen, Busch, Rödiger, & Hamm, 2016). Further research is required to explore vegan consumers' reactions to bio products.

Further, the present research suggests advancing qualitative research in this domain due to its novelty and innovativeness. In particular, qualitative studies would be important for identifying further variables that could have an impact on consumers' intentions toward products made from bioplastics, and integrate the theoretical model with other variables related, for instance, to consumers empathy (Lee, 2016), materialism (Raggiotto, Mason, & Moretti, 2018), or the purchase frequency of green products. Our findings also highlight the importance for future studies to address the awareness that consumers have of these innovative materials. In this vein, we invite scholars to adopt a configurational approach (e.g., qualitative comparative analysis) that could yield valuable insights in contexts with complex causality (Woodside, 2014) as the one emerging from our findings.

Finally, we welcome studies that would compare consumers' ages and genders to see if these can predict differences in attitudes and behaviors.

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Appendix A. Construct measures and confirmatory factor analysis results

Measures	Factor Loading	AVE	CR	Cronbach alpha
Perceived value		0.81	0.95	0.96
This product's environmental functions provide very good value for you.	0.92			
This product has more environmental concern than other products.	0.90			
This product is environmental friendly.	0.90			
This product has more environmental benefit than other products.	0.89			
Green self-identity		0.67	0.89	0.92
I think of myself as someone who is concerned about environmental issues	0.81			
I think of myself as a 'green' consumer	0.78			
Buying this chair would make me feel like a green consumer	0.84			
I would feel totally satisfied with myself if I bought this chair	0.85			
Self-congruity		0.81	0.93	0.96
I feel like I am part of the [green products] family.	0.89			
People who buy [green products] are very similar to me.	0.91			
Buying [green products] reflects who I am.	0.90			
Purchase intention		0.62	0.76	0.93
I'm likely to buy this chair.	0.77			
Given the information above, I'm willing to buy this chair.	0.80			
Switching intention		0.90	0.96	0.96
would consider switching from a conventional product to a bio-plastic product	0.91			
My likelihood of switching to bio-plastic products would be higher	0.97			
I am determined to switch to a bio-plastic chair	0.96			

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