Received: 1 February 2024 | Accepted: 17 June 2024

DOI: 10.1111/1467-8489.12578

The Australian Journal of Agricultural and Resource Economics AARES

ORIGINAL ARTICLE

Bioplastics in the basket of Italians: A hybrid framework for understanding the adoption of bioplastic food packaging

Giovanbattista Califano[1] | **Alessia Lombardi**[2] | **Teresa Del Giudice**[1] | **Francesco Caracciolo**[1] | **Luigi Cembalo**[1]

[1]Department of Agricultural Sciences, University of Naples Federico II, Naples, Italy

[2]Department of Veterinary Medicine and Animal Productions, University of Naples Federico II, Naples, Italy

Correspondence
Alessia Lombardi, Federico II – Department of Veterinary Medicine and Animal Productions, University of Naples, Naples, Italy.
Email: alessia.lombardi@unina.it

Abstract

This study provides a comprehensive understanding of the factors influencing Italian consumers' choice of biodegradable and compostable packaging by using a hybrid framework that integrates the theory of planned behaviour with a discrete choice experiment. By analysing the interplay between internal and external factors and rational consumer evaluations, the research clarifies that consumers' choices can be explained by a combination of economic and psychological models, offering a more accurate representation of the driving forces behind consumer decisions. Applying latent class analysis, we identify consumer segments based on packaging preferences for packaged salad, knowledge of waste disposal rules and the psychological characteristics of a statistically representative sample of Italian consumers. The integration of a comprehensive behavioural model allows for the identification of psychological determinants that influence consumer behaviour, outlining detailed profiles of both early adopters and those most opposed to this technology. This research contributes to the literature on sustainable packaging and offers insights to marketers and policymakers for promoting the adoption of sustainable packaging.

KEYWORDS

biodegradable and compostable packaging, choice experiment, consumer choice, Italian consumers, latent class, theory of planned behaviour

JEL CLASSIFICATION

C25, D1

1 | INTRODUCTION

Contemporary society has made excessive use of plastic (commercial, industrial and municipal) owing to its relevant properties such as high versatility, convenient market price, durability and lightness (Mitrano & Wagner, 2022). Despite the indisputable usefulness of plastics, their mismanagement is a serious concern for the environment (Kędzia & Turek, 2022; Rabiu & Jaeger-Erben, 2024), as it is considered one of the several causes of environmental pollution and biodiversity loss (Gall & Thompson, 2015; Halonen et al., 2020; Piracci et al., 2023). To illustrate, the polymers that compose plastics are unable to decompose completely, remaining in the air, soil and water as microplastics. The presence of microplastics in the environment is one of the agents of global change in terrestrial systems (de Souza Machado et al., 2018) due to their ability to interact with biological systems (Sridharan et al., 2021). Rethinking the development and use of plastics is central for governments and organisations, which constantly implement plastic-related actions and strategies (Walker, 2021). In this vein, after years in which innovations in plastic sustainability witnessed a slow decline, the scientific community, industry and governmental bodies, in line with sustainable development goal objectives,[1] have begun to seek to adopt more sustainable products and innovative technologies with alternative end-of-life options (Abrha et al., 2022; Kędzia & Turek, 2022). As approximately 40% of plastics produced are used for packaging (Raimondo et al., 2022), the question of how the sustainability of packaging can be improved is continuously being studied (Morinval & Averous, 2022). In the last two decades, the launch of bio-based plastics, in particular biodegradable and compostable packaging,[2] has made an important step towards this process (Morinval & Averous, 2022) due to their sustainable potential when correctly disposed of (Michaliszyn-Gabryś et al., 2022).

Despite the environmental opportunities for biodegradable packaging, the market is growing relatively slowly (Kędzia & Turek, 2022). As with any example of innovation, the launch of innovative packaging can be accepted by consumers in different ways, leading to contrasting perceptions, judgements and intentions to buy (Granato et al., 2022). The success of these new solutions depends on consumers' willingness to choose such alternatives (Borrello et al., 2021; Macena et al., 2021; Steenis et al., 2018). Moving from these assumptions, it is worth conducting a deep investigation of consumers' choices of food packaged with biodegradable and compostable materials.

Analysing consumer choice is a complex task influenced by a wide range of factors (Nocella et al., 2012; Shepherd et al., 1995). To illustrate, the models used in neoclassical economics assume that human behaviour, such as the choice of food products, is purely rational and depends on rational choices derived from the evaluation of differentiated products with different attribute levels (also known as a multi-attribute context) under budget constraints (Nocella et al., 2012). Consumers must judge and evaluate the many attributes of different products before choosing a product (Marshall, 1995). Among these attributes, some are easy to evaluate (e.g. price and organoleptic characteristics), whereas others are more complex to judge (e.g. credence attributes) (Lerro et al., 2021). In this vein, discrete choice experiments (DCEs) are widely implemented in consumer studies, assuming that consumers derive their utility from the attributes of a product (Nocella et al., 2012). Regarding food packaging, the previous literature has highlighted that although packaging is usually considered a peripheral factor in consumers' purchasing decisions, several packaging

[1]Rethinking the development and use of plastics is central to the United Nations (UN) goals of sustainable development goals. Specifically, the indicator 14.1.1 b under Goal 14 is expressly dedicated to reducing impact of microplastic in the oceans, and the dramatic and global environmental impact of plastics is of such a magnitude that governments and organization are constantly pushed to implement 'plastic-related' actions and strategies (Walker, 2021).

[2]Biodegradable and compostable plastics are defined *'as single polymer which degrade 60% within 180 days and multipolymers which degrade 90% within 180 days'* (Altekar, 2005; Dharmadhikari, 2012).

characteristics could influence these decisions in different ways (Bech-Larsen, 1996). Testa et al. (2021) showed that consumers' choice of food products could be influenced by 'the attractiveness, quality and eco-friendliness of the packaging'. Additionally, Rokka and Uusitalo (2008) demonstrated that environmentally labelled packaging could be considered one of the most relevant criteria when choosing products. Moreover, the introduction of novel food packaging may increase production costs and market prices, which can affect consumer choices (Han et al., 2018).

Models grounded in behavioural psychology have gained momentum in explaining consumers' choices, as consumers' individual choices depend mainly on their cognitive aspects, based on the relationship between attitudes and behaviours (Ajzen, 1991; Carvajal et al., 2004; Diamantopoulos et al., 2003; Sharma & Foropon, 2019). The theory of planned behaviour (TPB; Ajzen, 1991) is one of the most widely applied cognitive models to explain human behaviour in the realm of food choice (Dean et al., 2008).

However, when analysing consumers' food choices comprehensively, it is also important to consider both the internal and external factors that impact behavioural control. Factors such as consumer knowledge (internal factors) and product availability (external factors) can significantly influence behaviour. Recent studies have shed light on the significant role of consumer knowledge in shaping behaviour in the context of sustainable and pro-environmental choices. For example, the lack of knowledge about proper waste disposal is a significant obstacle to the development of compostable food packaging (Allison et al., 2021; Paraschiv et al., 2020). To fully capitalise on the potential benefits of bioplastics, it is necessary for consumers to not only perceive their environmental value but also to know how to correctly dispose of them (Taneepanichskul et al., 2022; Taufik et al., 2020).

Among the alternatives, individual choices such as purchasing food products with sustainable packaging are influenced by a wide range of factors. This process cannot be reduced to a simple bounded rational model or a behavioural psychological model. Rather, it should be understood as a balance between the behavioural psychological constructs of the TPB, such as attitudes, subjective norms, perceived behavioural control and the rational evaluation of specific product characteristics (Nocella et al., 2012). In addition to these factors, the study of individual food choices should also consider factors related to behavioural control.

While most previous studies have focussed on either DCE or stand-alone psychological concepts, very few have attempted to combine these two approaches. Moreover, the few studies that did combine both approaches have not implemented a comprehensive cognitive model, such as the TPB, especially in a food purchasing context (Yeh et al., 2021). Many of the models implemented in the area of consumer food choice only list the possible influences of some psychological factors, rather than proposing a complete framework useful for empirical research. Indeed, a method to integrate all these factor groups into a unified model that better captures the complexities of consumer food choice has become a requirement. This study aims to bridge this gap in the existing literature by pursuing a twofold research objective. First, we aim to develop a comprehensive model that accounts for the role and interplay of three key consumption drivers—behavioural control, psychological aspects and rational consumer evaluation—in shaping consumer choices. To this end, we draw on the hybrid model proposed by Ben-Akiva et al. (2002) as our theoretical framework and integrate these factors into a comprehensive framework that combines behavioural (i.e. TPB) and predictive (i.e. DCE) choice analyses. Empirically, our approach follows a three-stage methodology involving partial least squares structural equation modelling (PLS-SEM), a latent class choice model (LCCM) and multinomial logistic regression (MLR).

Second, we aim to apply this enhanced understanding of the dynamic interactions between these factors to clarify consumer preferences for more sustainable packaging. Both objectives pursued in this study are essential for addressing the research question that will be examined in a statistically representative sample of Italian consumers: *How are preferences for food*

packaging materials influenced by the interplay between behavioural control, psychological aspects and rational consumer evaluation?

Hybrid models for analysing consumers' food choices are not new in the literature (Nocella et al., 2012; Yeh et al., 2021). For instance, Piracci et al. (2023) considered two different decision paradigms in the decision-making process for sustainable packaging: the traditional random utility maximisation approach, as in DCE applications, and the random regret minimisation framework, according to which individuals act to minimise their anticipated emotions such as anticipated regret. In the same line, Lehberger et al. (2024) conducted a model combining a quantitative analysis such as choice-based conjoint analyses and a qualitative analysis of data from 13 interviewees to identify the role packaging plays in consumer choice.

The innovativeness of the current work, compared with the existing literature, lies in the use of a complete TPB model, complemented by an internal factor related to actual behavioural control, to identify the determinants of consumers' behaviour and outline a more detailed profile of early adopters. Results of our study provide more details on individual factors that drive consumers towards sustainable choices. In detail, outcomes illustrate how intentions to implement pro-environmental behaviour, such as the choice of biodegradable and compostable packaging, require the support of knowledge and awareness of the practical aspects of different food packaging and its possible effect on the environment. Business actors can gain more information on how to involve consumers in the choice of biodegradable and compostable packaging, and policymakers may learn what aspects and factors could be improved to better develop and promote the sustainable packaging sector.

The remainder of this paper is organised as follows. The next section provides an explanation of the conceptual framework and detailed model specifications. The third section provides a description of the empirical approach. The fourth section illustrates the questionnaire. The fifth section presents the findings. The last section draws conclusions along with some suggestions for future research steps to develop further environmental strategies.

2 | THE HYBRID MODEL

The study of choice behaviour is of interest in multiple disciplines, including economics, engineering, psychology and marketing. Choice research has two main domains: predictive choice models and behavioural choice analysis (Ben-Akiva et al., 2002) (Figure 1).

2.1 | Discrete choice experiments

DCEs are based on the random utility model (McFadden, 1974) and Lancaster's consumer theory, which assume that the sum of product characteristics (i.e. attributes) determines the utility a consumer derives from them (Lancaster, 1966). Given a set of alternatives, decision-makers choose a product that maximises their utility.

In this study, we used the DCE to explore consumer preferences for packaged salads, a commonly purchased fourth-range product in Italy, sold in plastic bags. The experimental design was developed using the modified Fedorov algorithm (Carlsson & Martinsson, 2003; Zwerina et al., 1996), following a pilot study conducted with 300 participants. After selecting the design that provided the highest D-efficiency, we organised 12 choice sets into four blocks, with each participant being presented with three choice sets. In each choice set, the participants were tasked with expressing their preferences among three multi-attribute alternatives (Hensher et al., 2015), enabling them to compare and evaluate their preferences. The attributes considered included whether the product was organic, the transparency of the packaging (transparent or opaque), the packaging material (conventional plastic, recycled plastic, biodegradable

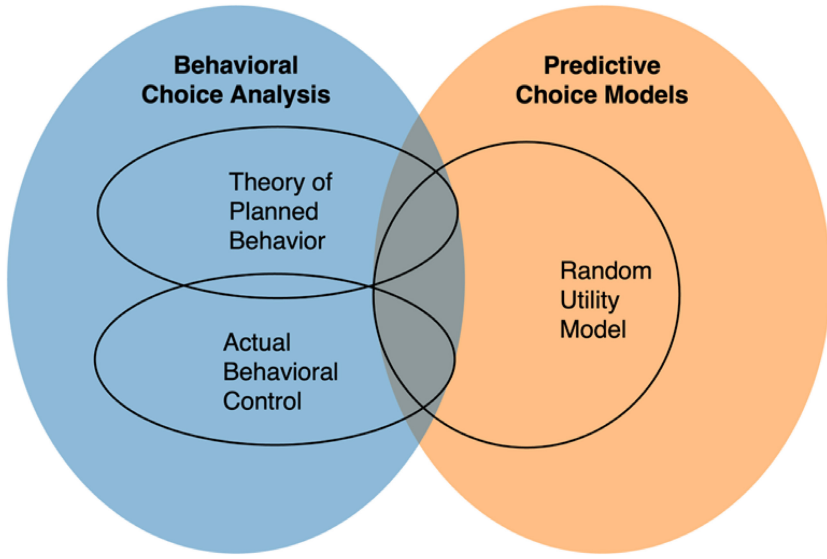

FIGURE 1 Domains of Choice Research. *Source*: adapted from Ben-Akiva et al., 2002. [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 1 Packaged salad: attributes and levels considered.

Attribute	Level
Organic	No (*reference*)
	Yes
Packaging transparency	Transparent (*reference*)
	Opaque
Packaging material	Conventional plastic (*reference*)
	Recycled plastic
	Biodegradable and compostable
Price	0.99€
	1.99€

Note: Packaging material levels are herein shown in their order of environmental impact.

and compostable material) and price (Table 1). Three price levels were originally selected for the pilot study and were reduced to two in the D-optimal design for the final version of the questionnaire, representing low and high pricing tiers in the Italian context. Regarding the packaging material, while our primary focus was on the biodegradable and compostable option, we also aimed to compare it with another 'more sustainable' option, namely recycled plastic. Additionally, we incorporated the attribute of transparency, as most biodegradable and compostable materials currently available in the market are opaque. This characteristic may result in consumer aversion, as individuals often prefer to visually assess fourth-range products before committing to a purchase.

While DCEs provide a powerful tool for understanding how people make choices and how they value the different attributes of the alternatives they are considering, it is well-established that preference structures are likely to vary across individuals and are shaped by a variety of factors (Ortega et al., 2011). Among these factors, psychological constructs have garnered

significant attention in the literature (Caracciolo et al., 2016). In recent years, researchers have sought to combine latent variables with choice models (Contini et al., 2023; Fantechi et al., 2022; Nocella et al., 2012; Ortega et al., 2011; Yangui et al., 2016). As Ben-Akiva et al. (2002) argued, the philosophy guiding this approach is that the incorporation of psychological factors leads to a more realistic representation of the choice process from a behavioural perspective and, consequently, to better explanatory power. Nevertheless, while most previous studies have focussed on integrating standalone psychological variables, very few have attempted to combine DCEs with comprehensive cognitive models, such as TPB, especially in a food purchasing context (Yeh et al., 2021).

2.2 | Theory of planned behaviour

TPB has been widely used to understand pro-environmental behaviours. According to TPB, a given behaviour can be mostly explained by the intention to enact it, which, in turn, is predicted by three key cognitions: attitude (i.e. overall positive or negative evaluation of the behaviour), subjective norms (i.e. perceived pressure from significant others to enact the behaviour) and perceived behavioural control (i.e. perception of capability and/or possibility to perform the chosen behaviour) (Ajzen, 1991).

Therefore, this study hypothesises that the intention to purchase food with biodegradable and compostable packaging is positively influenced by attitude, subjective norms and perceived behavioural control.

2.2.1 | Actual behavioural control as internal factor

Although behavioural intentions are great tools for explaining behaviours, the link between intention and behaviour is not as straightforward, and internal factors related to actual (rather than perceived) behavioural control, such as skills or knowledge, can moderate this relationship (Ajzen, 2020). The phenomenon of the intention–behaviour gap, which refers to the discrepancy between individuals' intentions to perform a behaviour and their actual behaviour, has been closely linked to TPB (Montano & Kasprzyk, 2015). This gap is particularly important in the context of pro-environmental behaviours, as evidenced by the growing body of research examining the 'green gap' (ElHaffar et al., 2020). The 'green gap' refers to the tendency of individuals to express positive attitudes and intentions towards pro-environmental behaviours but failure to follow through with corresponding actions.

In the context of this study, accurate knowledge of how to dispose of different materials could play a relevant role. For instance, one might have a high intention to purchase food in biodegradable and compostable packaging, perhaps guided by strong pro-environmental beliefs, and when faced with several alternatives, might prefer another packaging that is considered equally or more sustainable (even if that is not the case).

2.3 | Integrating DCEs and TPB using a latent class model

Integrating the TPB and DCEs models is a theoretical and methodological process. From the econometric perspective, in DCE models, there are three main approaches to analysing the role of individual characteristics in influencing preferences: (i) by including them directly in the utility function as interaction effects of the attributes (e.g. Nocella et al., 2012); (ii) by following a two-stage approach, in which the individual preferences, with their unconditional heterogeneity, can be estimated using a random parameter model and, subsequently,

preferences determinants can be identified through a separate analysis (Califano & Spence, 2024; Campbell, 2007); and (iii) by implementing a latent class model, in which preferences are considered discretely distributed in clusters, and class-specific parameters in each segment can be estimated (Fu, 2021).

While all the empirical methodologies above can be considered appropriate and theoretically consistent for investigating preference heterogeneity in DCEs, when it comes to a hybrid specification that includes formalised models, such as the TPB, the three approaches cannot be considered strictly interchangeable because they might imply different theoretical assumptions. For instance, using Method (i), the authors generally interpret the choices stated within the DCE as behavioural intentions and measure the effects of the antecedents (e.g. attitude, subjective norms and perceived behavioural control) through moderation with marginal utilities (e.g. Nocella et al., 2012; Shan et al., 2019). In Method (ii), marginal utilities are considered explicit measures of a stated behaviour; therefore, they are embedded as the ultimate outcome of a complete TPB model (e.g. Yeh et al., 2021). The latent class Method (iii) provides a more conservative approach because no structural relationships between TPB and DCE are assumed, whereas the outcome of the TPB model is used to identify class-specific structures of preferences, explaining the heterogeneity at the margin. Furthermore, Method (iii) can be used as a functional approach to combine the three components of our framework (TPB, actual behavioural control and DCE).

3 | EMPIRICAL APPROACH

To integrate the three key components of the hybrid model, a three-stage approach was used (Figure 2), which involved PLS-SEM, the LCCM and MLR.

First, PLS-SEM was implemented for TPB to estimate the relationships between latent variables and their indicators (outer/measurement model), and the relationships among latent constructs (inner/structural model), thus verifying whether the intention to purchase food in biodegradable and compostable packaging is positively influenced by attitude, subjective norms and perceived behavioural control (Venturini & Mehmetoglu, 2019).

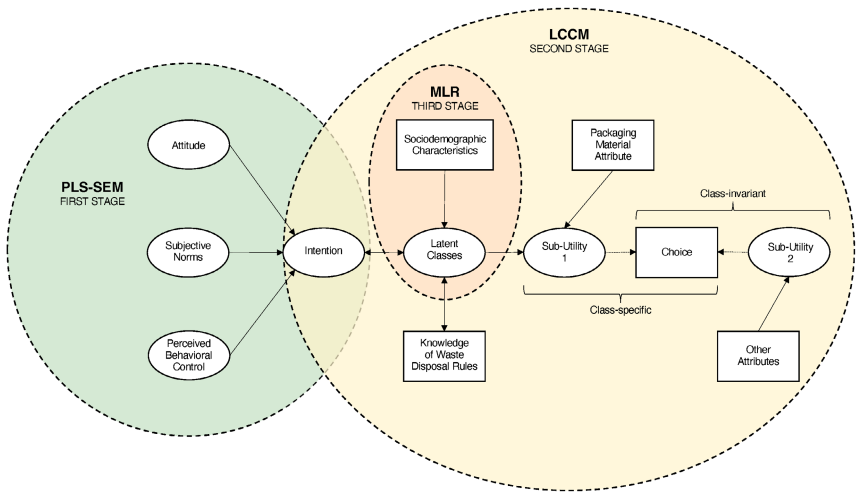

FIGURE 2 Hybrid framework. *Note*: Intention, Knowledge, and sociodemographic characteristics would be indistinctly defined as covariates. However, in this model Intention and Knowledge (double arrows) concur to latent class formation, whereas sociodemographic characteristics are membership predictors, and they do not interfere with class composition. [Colour figure can be viewed at wileyonlinelibrary.com]

To link TPB to the second stage, the predicted latent scores of intentions were used in the LCCM as covariates after evaluating the goodness of fit of both the measurement and structural models. Therefore, the LCCM was used to capture the heterogeneity in preferences, intentions and knowledge together (Nylund-Gibson et al., 2014). The aim is to identify latent classes of consumers who specifically differ in their intention to purchase food with biodegradable and compostable packaging (as predicted by the TPB), their knowledge of waste disposal rules and the utility they derive from different packaging materials. In LCCM, heterogeneity in preferences and individual characteristics is assumed between segments, whereas consumers within a segment are assumed to be homogeneous (see, e.g. Yoo, 2020 for a formal specification).

Once the LCCM model was estimated, the marginal value of the attribute (MVA) in monetary terms was calculated by taking the ratio of the parameter for non-monetary attributes to the price parameter multiplied by minus one.

The final stage of our analysis was perhaps the most informative for marketers and policymakers as it involved the exploration of sociodemographic and economic variables as predictors of latent class membership. A common approach to investigate the relationships between external variables and latent classes is to assign each participant to their most likely membership class, based on the estimated posterior probabilities. However, this approach fails to account for misclassification errors (Bakk et al., 2014). Hence, the maximum likelihood (ML) three-step approach (Vermunt, 2010) was used to minimise bias in the parameter estimates of MLR. All statistical analyses were performed using Stata 18.[3]

4 | QUESTIONNAIRE AND SAMPLE

Data were collected by a leading company in market research, which administered an online survey to a representative panel of Italian consumers in September 2022. Statistical representativeness was ensured for individuals over 18 years of age, by gender and by geographical distribution. The sample consisted of 856 Italians responsible for household food purchases. Before completing the questionnaire, the participants were informed about the anonymity of the data collection and signed an informed consent form. The questionnaire comprises five main sections, and each question or item required a mandatory answer to avoid missing values.

In Section 1, participants were asked to answer questions regarding their food purchasing habits, such as the type of store where they generally purchase food, frequency of consumption of fruits and vegetables, and frequency of purchase of fourth-range products.

Section 2 presented a choice experiment for packaged salads (Figure 3).

In Section 3, participants completed a series of psychographic measures. All items for the TPB constructs are presented in Appendix S1 (Table A1).

In Section 4, the participants answered four questions to assess their knowledge of waste disposal rules (Table 2). One point was assigned for each correct answer, and zero points for missing or incorrect answers. The total score, ranging from 0 to 4 ($M = 2.52 \pm 1.09$ *SD*), was used for subsequent analyses.

Finally, Section 5 presents the sociodemographic characteristics of the respondents, such as age, gender and income. Table 3 presents the main descriptive statistics of the sample.

[3]PLS-SEM, LCMM and MLR were performed using community-contributed software for Stata, respectively: plssem (Venturini & Mehmetoglu, 2019), lclogit2 (Yoo, 2020), and step3 (Califano, 2023).

FIGURE 3 Choice task example. [Colour figure can be viewed at wileyonlinelibrary.com]

5 | RESULTS

5.1 | First stage: Results of PLS-SEM

PLS-SEM was used to estimate the TPB. The measurement model showed strong relationships between the latent constructs and items, with factor loadings ranging from 0.829 to 0.935 (Table 4). The discriminant validity of the measurement model and the

TABLE 2 Questions asked to assess participants' knowledge of waste disposal rules and percentage.

Question	Option	Percentage
1. In which of the following bins would you throw a biodegradable plastic package?	**(a) Plastic**	**32%**
	(b) Compost	49%
	(c) Paper	4%
	(d) Undifferentiated	6%
	(e) Glass	0%
	(f) I do not know	9%
2. In which of the following bins would you throw a package made of compostable material?	(a) Plastic	5%
	(b) Compost	**70%**
	(c) Paper	6%
	(d) Undifferentiated	9%
	(e) Glass	0%
	(f) I do not know	10%
3. In which of the following bins would you throw a package made of biodegradable and compostable material?	(a) Plastic	4%
	(b) Compost	**71%**
	(c) Paper	4%
	(d) Undifferentiated	9%
	(e) Glass	1%
	(f) I do not know	11%
4. In which of the following bins would you throw a package made of non-recyclable material?	(a) Plastic	9%
	(b) Compost	2%
	(c) Paper	2%
	(d) Undifferentiated	**79%**
	(e) Glass	1%
	(f) I do not know	7%

Note: Correct answers are indicated in bold.

multicollinearity check for the structural model are presented in the Appendix S1 (Tables A2 and A3, respectively).

Figure 4 presents the results of the TPB with standardised direct effects between the considered constructs. All path coefficients were significant and exhibited the expected signs.

5.2 | Second stage: Results of LCCM

The Akaike information criterion (AIC) and Bayesian information criterion (BIC) for model selection identified three consumer segments as the best grouping solutions (Table 5) (Weller et al., 2020).

The results in Table 6 describe the influence of knowledge of waste disposal rules and behavioural intention predicted by the TPB ($R^2 = 0.57$) on conditioning the probability for each individual to be grouped into Class 1 and Class 2, both with respect to Class 3 (such relationships are graphically represented through a two-way contour plot in Figure 5).

Compared with the largest segment, Class 3, which represented 51% of respondents, higher levels of knowledge were associated with lower probabilities of being assigned to both Class 1 (14%) and Class 2 (35%). However, increasing behavioural intention only reduced the likelihood

TABLE 3 Descriptive statistics of the sample.

Variable	*n*	Percentage
Gender		
Man	423	49%
Woman	433	51%
Education		
Primary school	3	0%
Junior high school	56	7%
High school	538	63%
University degree or higher	259	30%
Income		
Below 2000€ per month	411	48%
Between 2000€ and 4000€ per month	368	43%
Above 4000€ per month	77	9%
Age		
18–24 years old	80	9%
25–34 years old	124	14%
35–44 years old	144	17%
45–54 years old	184	22%
55–64 years old	176	21%
65–75 years old	148	17%
Number of family members		
1	106	12%
2	243	28%
3	239	28%
4	202	24%
5 or more	66	8%
Italian geographical region		
Northern-West	230	27%
Northern-East	167	20%
Central	193	23%
Southern and Islands	266	31%
Favourite shopping place for food		
Supermarket	752	88%
Market	20	2%
Small shop	84	10%

of being assigned to Class 1. Thus, knowledge about waste disposal rules was relatively low in Class 1 and Class 2, whereas the behavioural intention predicted by the TPB was equally higher in Classes 2 and 3 than in Class 1 (Table A4, Appendix S1).

Table 7 presents the results of the choice models for each latent class. Regarding the class-invariant coefficients, those related to price and opaque packaging were negative (MVA = −0.69€), while the coefficient related to organic certification was positive (MVA = 0.57€).

Regarding the class-specific estimates (related to packaging material), Class 1 (*Low Intention/Low Knowledge*) showed a preference for conventional plastic packages (MVA for

TABLE 4 Factor loadings, Cronbach's α and Rho A of the measurement model.

	PBC	INT	ATT	SN
PBC.1	0.892			
PBC.2	0.872			
PBC.3	0.829			
INT.1		0.927		
INT.2		0.935		
INT.3		0.927		
ATT.1			0.898	
ATT.2			0.855	
ATT.3			0.856	
SN.1				0.947
SN.2				0.928
SN.3				0.930
Cronbach α	0.832	0.921	0.840	0.928
Rho A	0.845	0.921	0.846	0.929

Abbreviations: ATT, Attitude; INT, Intention; PBC, Perceived Behavioural Control; SN, Subjective Norm.

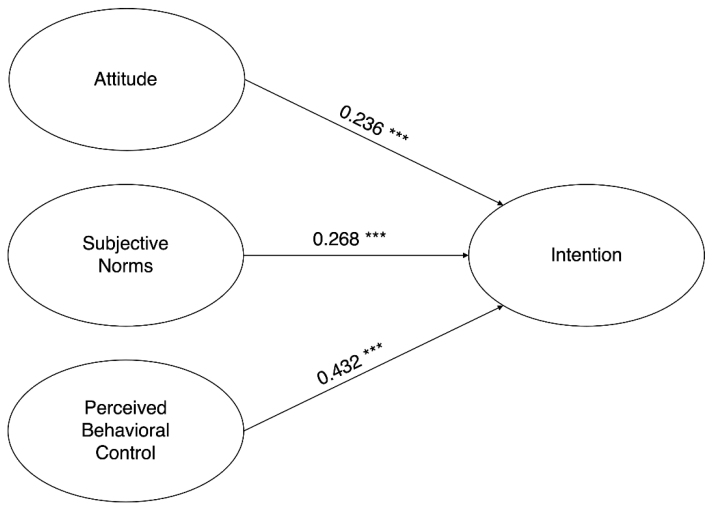

FIGURE 4 Path coefficient values of the structural model. *Note*: ***$p < 0.01$; $R^2 = 0.57$.

bioplastic = − 0.83€; MVA for recycled plastic = −2.43€), Class 2 (*High Intention/Low Knowledge*) showed a preference for packages made from recycled plastic (MVA = 0.94€), and Class 3 (*High Intention/High Knowledge*) showed a preference for biodegradable and compostable packages (MVA = 1.07€).

5.3 | Third stage: Results of MLR

To gather additional information on the latent class profiles, MLR was employed, using the ML three-step approach. Compared with Class 3 (*High Intention/High Knowledge/Preference for bioplastic*), Class 1 and Class 2 were more likely to be younger and shop for food in markets

and small shops rather than supermarkets. Moreover, Class 1 (*Low Intention/Low Knowledge/Preference for conventional plastic*) was more likely to have purchased fourth-range products and less likely to have purchased food with biodegradable and compostable packaging, whereas Class 2 (*High Intention/Low Knowledge/Preference for recycled plastic*) was less likely to have a high level of education (i.e. high school or higher) (Table 8).

6 | DISCUSSION

Our main research question was answered positively, as rational consumer evaluation of different packaging materials (with different levels of sustainability) varied according to psychological aspects and actual behavioural control, namely, accurate knowledge of waste disposal rules. Furthermore, interesting insights resulting from the interplay of these key components are addressed below.

Based on the psychological aspects shaping consumers' intention to buy food with biodegradable and compostable packaging, the findings fully support the effectiveness of TPB in understanding pro-environmental behaviours, such as buying food with sustainable packaging (Tuwanky et al., 2018; Prakash & Pathak, 2017; Santos et al., 2021). Moreover, among the constructs of the TPB, perceived behavioural control was found to be the most crucial factor influencing purchase intention. In other words, if individuals feel that they have the necessary resources, knowledge, and skills to perform green behaviours, they are more likely to have a higher intention to do so. This result is consistent with Yadav and Pathak's (2017) research on purchase intentions for green products. This underscores the importance of ensuring favourable conditions, such as availability, which make it easier for consumers to decide to purchase green products (De Leeuw et al., 2015). However, it is easier to self-assess external factors that affect behavioural control, such as product availability in usual shopping locations, than to evaluate internal factors, such as knowledge and skills (e.g. Kruger & Dunning, 1999).

To better understand the relationship between intention, accurate knowledge of waste disposal rules (i.e. internal factors related to actual behavioural control) and rational consumer evaluation of packaging material, in the second stage of our analysis, we used LCCM, and three latent classes were selected as the best grouping solutions. First, Class 3 included 51% of the sample with a high level of knowledge and high intention to choose biodegradable and compostable packaging. This result, which highlights the 'green flag' of a large share of consumers, is coherent with the data from Circular Economy Network (2022), which underlined the higher recycling rate of Italians (72%) compared with European average (53%). Among the other segments of the population, Class 2 was the most interesting, showing the same high levels of intention as Class 3, but a lower accurate knowledge of waste disposal rules, akin to that of Class 1. Indeed, Class 2 preferred the second-best alternative in terms of sustainability, namely packaging made of recycled plastic. Although high levels of intention may be associated with preferences for more sustainable materials such as recycled plastics, a quantum leap in sustainability also requires knowledge of the features of different materials, the impact of packaging materials on the environment and their correct disposal methods. In this regard, Otto et al. (2021) and Lehberger et al. (2024) found that consumers evaluate food packaging based on affective feelings rather than on clear knowledge of environmental impacts.

It seems evident that consumers need clear guidance to make informed decisions (Cembalo et al., 2019), and previous research conducted by Dilkes-Hoffman et al. (2019) has already highlighted how consumers wrongly associate the concept of bioplastics (and their disposal method) with recyclable plastic. Moreover, this misinterpretation is worsened by the fact that biodegradable, and more generally bio-based plastics, are often indistinguishable from other types of plastics because of the confusing waste sorting process (Prakash & Pathak, 2017). An interesting solution could be to make biodegradable and compostable packaging clearly

TABLE 5 Latent classes' goodness of fit.

Classes	DF	LL	AIC	BIC
1	5	−2182.750	4375.499	4410.247
2	10	−2130.008	4280.015	4349.510
3	15	−2096.191	4222.381	4326.624

Note: Estimates from 7704 observations. The model failed to converge beyond the 3-class solution.

Abbreviations: AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; DF, Degrees of Freedom; LL, Log Likelihood.

TABLE 6 Class membership model, with Class 3 being the reference.

	Class 1		Class 2	
	Estimate	Std. err.	Estimate	Std. err.
Intention	−0.409*	0.221	−0.119	0.160
Knowledge	−0.670***	0.172	−0.232*	0.121
Constant	0.179	0.517	0.228	0.426

Note: Intention—Intention to purchase food in biodegradable and compostable packaging, as predicted by the PLS-SEM results ($R^2 = 0.57$). Knowledge—Knowledge of waste disposal rules.

*$p < 0.10$ ***$p < 0.01$

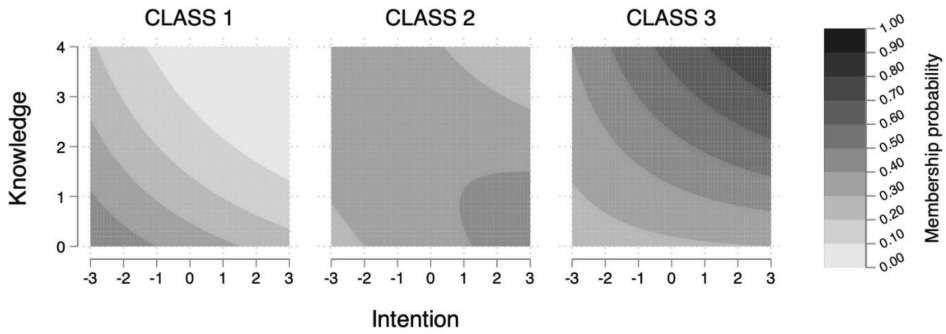

FIGURE 5 Predicted posterior probability of belonging to each Class by Intention and Knowledge.

distinguishable from other types of plastics by implementing clear standards and labelling. Policymakers should focus on distinct communication campaigns with citizens in favour of sustainable packaging, waste disposal processes and complete label information systems (Thøgersen, 2005). This is particularly important for consumers who are less likely to purchase foods with biodegradable and compostable packaging.

Our results have highlighted that Italian consumers are willing to choose pro-environmental packaging as substitutes for plastic; this change in consumers' behaviour can contribute to limiting environmental issues related to plastic use. However, to make this change operational, it is necessary that packaging companies choose to produce and use sustainable packaging instead of simply mention waste management and recycling practices in their corporate sustainability reports (Beitzen-Heineke et al., 2017; Piracci et al., 2023;). In other words, consumers' acceptance and willingness to choose biodegradable and compostable packaging could incentivise companies to gradually shift towards bioplastic packaging. Accordingly, marketing managers should analyse consumers' motivations towards choosing this type of packaging and target

TABLE 7 Choice model results, with class-specific and class-invariant estimates.

	Class 1 *Low Intention/Low Knowledge*		Class 2 *High Intention/Low Knowledge*		Class 3 *High Intention/High Knowledge*	
	Estimate	**Std. err.**	**Estimate**	**Std. err.**	**Estimate**	**Std. err.**
Bioplastic	−1.140***	0.386	−0.276	0.260	1.471***	0.203
Recycled	−3.337***	0.896	1.289***	0.188	0.260	0.233
Price	−1.375***	0.062	−1.375***	0.062	−1.375***	0.062
Organic	0.784***	0.054	0.784***	0.054	0.784***	0.054
Opacity	−0.951***	0.058	−0.951***	0.058	−0.951***	0.058

Note: 'Bioplastic'—biodegradable and compostable packaging; 'Recycled'—packaging made from recycled plastic. Both attribute levels were compared with conventional plastic packaging. Attributes in italic were estimated as class-invariant.
***$p < 0.01$.

TABLE 8 Multinomial logistic regression results, with Class 3 (*High Intention/High Knowledge/Preference for bioplastic*) as reference.

	Class 1 *Low Intention/Low Knowledge Preference for conventional*		Class 2 *High Intention/Low Knowledge Preference for recycled*	
	Estimate	**RRR**	**Estimate**	**RRR**
Age	−0.027*	0.974	−0.026***	0.975
Woman	−0.527	0.590	−0.309	0.734
High income	−0.029	0.972	0.359	1.432
High education	−1.019	0.361	−0.988*	0.372
Past bioplastic experience	−0.506**	0.603	−0.095	0.909
Fruit and vegetable consumption	−0.304	0.738	0.182	1.200
Fourth-range consumption	0.454**	1.575	0.089	1.094
Market/small shops (vs. *Supermarket*)	1.451**	4.268	1.169**	3.217
Constant	2.209	9.102	0.998	2.712

Note: RRR, Relative Risk Ratio; 'Past bioplastic experience'—frequency of purchasing food in biodegradable and compostable packaging; 'Fourth-range consumption'—frequency of purchasing fourth-range products; 'Market/Small shops' —habitual shopping place for food.
*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

effective marketing strategies. Many authors (Jacobsen et al., 2022; Rivers et al., 2017) have analysed different communication tools, messages or nudging solutions; however, the results have not yet been satisfactory.

Regarding the results of DCE, the preference for bioplastics could be undermined by characteristics often associated with these materials, such as opacity. The DCE results are well-supported by the literature, particularly for fourth-range products; package transparency is a feature highly requested by consumers, as it increases perceptions of trustworthiness, expected quality and freshness, and hence purchase intentions and product choice (Billeter et al., 2012; Simmonds et al., 2018).

The estimated price coefficient is statistically significant and, as expected, has a negative sign. Previous studies have shown contrasting results when purchasing biodegradable and compostable packaged food products. To illustrate, Hermann et al. (2022) found a negative willingness to pay a premium price for bioplastics; in the same vein,

Chekima et al. (2016) found higher priced (sustainable) packaging to be a barrier for purchasing intentions. By contrast, other studies have highlighted that consumers with high concerns about environmental and sustainability issues are willing to pay premium prices for food products sold in sustainable packaging (Cronin et al., 2011; Grankvist & Biel, 2001; Martinho et al., 2015).

Finally, the positive sign of 'organic' as an attribute is as expected: Organic certification represents a driving factor in choosing sustainable packaging. Moreover, the attribute 'organic', together with sustainable packaging, increases consumers' perception of quality and naturalness and, therefore, represents a profitable strategy for companies (Magnier et al., 2016).

In the third and final stage, the MLR results highlighted that the 'virtuous' consumers in Class 3 were more likely to be older and shop for food in supermarkets rather than small shops and markets. This result is consistent with previous studies: Although young consumers are generally more concerned about the environment, they are less involved in pro-environmental behaviour than older consumers (Gifford & Nilsson, 2014; Rastegari Kopaei et al., 2021).

Moreover, shopping in small stores or markets, whether by choice or necessity, offers fewer options and fewer chances to find products with more sustainable packaging. Consistent with the results related to accurate knowledge, consumers in Class 2 were less likely to have a higher level of education than those in Class 3. Finally, consumers in Class 1 seemed to be the main buyers of fourth-range products, which is worrisome considering their aversion to more sustainable packaging. This reinforces the need for an effective communication system.

7 | CONCLUSIONS

The objectives of this study were twofold: First, we aimed to develop a comprehensive model that accounts for the role and interplay of three key consumption drivers: behavioural control, psychological aspects and rational consumer evaluation. Second, we applied this comprehensive model to gain insight into the factors driving consumer preferences for sustainable packaging. The proposed hybrid model allowed us to indirectly see, and partially address, what appears to be a 'green gap' between pro-environmental intention and behaviour, visible in the 35% of the sample (Class 2), though it is generally difficult to assess such gaps in cross-sectional studies with self-reported questionnaires. Limiting the approach to only the TPB or DCE model would thus have obscured a remarkable result, which suggests the need to increase and improve Italian consumers' knowledge of new sustainable materials, as well as the proper ways to dispose of them. Further limitations may be due to the use of DCEs, as they are often based on simplified scenarios that may not fully capture the complexity of the real world.

In response to the clear propensity of Italian consumers to accept and choose innovative sustainable packaging with biodegradable and compostable materials, there is a need to focus on several critical aspects related to companies as well as educational, systemic, political and legislative activities. Better education and information for consumers and organisations are necessary to improve proper knowledge of packaging features and correct home waste disposal methods.

Future studies may delve into the role of other potentially relevant factors in the 'green gap', perhaps through longitudinal studies, and explore the role of other variables that may influence consumer attitudes towards innovative and more sustainable food packaging.

ACKNOWLEDGEMENTS

Open-access funding provided by Università degli Studi di Napoli Federico II within the CRUI-CARE Agreement. This research received grant from the project BIODEGRAPACK: 'Pellicole EMAP innovative basate sull'utilizzo di materie prime rinnovabili e biodegradabili per una migliore shelf life e qualità dei prodotti biologici'—E78D19000800001—funded by the Italian Ministry of Agricultural Policies.

CONFLICT OF INTEREST STATEMENT

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

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Alessia Lombardi https://orcid.org/0000-0002-5862-0283

REFERENCES

Abrha, H., Cabrera, J., Dai, Y., Irfan, M., Toma, A., Jiao, S. et al. (2022) Bio-based plastics production, impact and end of life: a literature review and content analysis. *Sustainability*, 14(8), 4855. Available from: https://doi.org/10.3390/su14084855

Ajzen, I. (1991) The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211.

Ajzen, I. (2020) The theory of planned behavior: frequently asked questions. *Human Behavior and Emerging Technologies*, 2(4), 314–324. Available from: https://doi.org/10.1002/hbe2.195

Altekar, R. V. (2005). *Supply Chain Management: Concepts and Cases*. Delhi: PHI Learning.

Allison, A.L., Lorencatto, F., Michie, S. & Miodownik, M. (2021) Barriers and enablers to buying biodegradable and compostable plastic packaging. *Sustainability*, 13(3), 1463. Available from: https://doi.org/10.3390/su13031463

Bakk, Z., Oberski, D.L. & Vermunt, J.K. (2014) Relating latent class assignments to external variables: standard errors for correct inference. *Political Analysis*, 22(4), 520–540. Available from: https://doi.org/10.1093/pan/mpu003

Bech-Larsen, T. (1996) Danish consumers' attitudes to the functional and environmental characteristics of food packaging. *Journal of Consumer Policy*, 19(3), 339–363.

Beitzen-Heineke, E.F., Balta-Ozkan, N. & Reefke, H. (2017) The prospects of zero-packaging grocery stores to improve the social and environmental impacts of the food supply chain. *Journal of Cleaner Production*, 140, 1528–1541. Available from: https://doi.org/10.1016/j.jclepro.2016.09.227

Ben-Akiva, M., McFadden, D., Train, K., Walker, J., Bhat, C., Bierlaire, M. et al. (2002) Hybrid choice models: Progress and challenges. *Marketing Letters*, 13, 163–175.

Billeter, D., Zhu, M., & Inman, J. J. 2012. Transparent packaging and consumer purchase decisions. *ACR North American Advances*.

Borrello, M., Cembalo, L. & Vecchio, R. (2021) Role of information in consumers' preferences for eco-sustainable genetic improvements in plant breeding. *PLoS One*, 16(7), e0255130.

Califano, G. (2023) *STEP3: Stata module to relate latent class membership to external variables*. Statistical Software Components. Boston College Department of Economics. Available from: https://EconPapers.repec.org/RePEc:boc:bocode:s459182

Califano, G. & Spence, C. (2024) Consumer preference and willingness to pay for 3D-printed chocolates: a discrete choice experiment. *Future Foods*, 9, 100378. Available from: https://doi.org/10.1016/j.fufo.2024.100378

Campbell, D. (2007) Willingness to pay for rural landscape improvements: combining mixed logit and random-effects models. *Journal of Agricultural Economics*, 58(3), 467–483. Available from: https://doi.org/10.1111/j.1477-9552.2007.00117.x

Caracciolo, F., Cicia, G., Del Giudice, T., Cembalo, L., Krystallis, A., Grunert, K.G. et al. (2016) Human values and preferences for cleaner livestock production. *Journal of Cleaner Production*, 112, 121–130. Available from: https://doi.org/10.1016/j.jclepro.2015.06.04

Carlsson, F. & Martinsson, P. (2003) Design techniques for stated preference methods in health economics. *Health Economics*, 12(4), 281–294. Available from: https://doi.org/10.1002/hec.729

Carvajal, S.C., Hanson, C., Downing, R.A., Coyle, K.K. & Pederson, L.L. (2004) Theory-based determinants of youth smoking: a multiple influence approach 1. *Journal of Applied Social Psychology*, 34(1), 59–84. Available from: https://doi.org/10.1111/j.1559-1816.2004.tb02537.x

Cembalo, L., Caso, D., Carfora, V., Caracciolo, F., Lombardi, A. & Cicia, G. (2019) The "land of fires" toxic waste scandal and its effect on consumer food choices. *International Journal of Environmental Research and Public Health*, 16(1), 165. Available from: https://doi.org/10.3390/ijerph16010165

Chekima, B., Syed KhalidWafa, S.A.W., Igau, O.A., Chekima, S. & Sondoh, S.L. (2016) Examining green consumerism motivational drivers: does premium price and demographics matter to green purchasing? *Journal of Cleaner Production*, 112, 3436–3450. Available from: https://doi.org/10.1016/j.jclepro.2015.09.102

Contini, C., Boncinelli, F., Piracci, G., Scozzafava, G. & Casini, L. (2023) Can blockchain technology strengthen consumer preferences for credence attributes? *Agricultural and Food Economics*, 11(1), 27. Available from: https://doi.org/10.1186/s40100-023-00270-x

Cronin, J.J., Smith, J.S., Gleim, M.R., Ramirez, E. & Martinez, J.D. (2011) Green marketing strategies: an examination of stakeholders and the opportunities they present. *Journal of the Academy of Marketing Science*, 39, 158–174. Available from: https://doi.org/10.1007/s11747-010-0227-0

De Leeuw, A., Valois, P., Ajzen, I. & Schmidt, P. (2015) Using the theory of planned behavior to identify key beliefs underlying pro-environmental behavior in high-school students: implications for educational interventions. *Journal of Environmental Psychology*, 42, 128–138.

de Souza Machado, A.A., Kloas, W., Zarfl, C., Hempel, S. & Rillig, M.C. (2018) Microplastics as an emerging threat to terrestrial ecosystems. *Global Change Biology*, 24(4), 1405–1416. Available from: https://doi.org/10.1111/gcb.14020

Dean, M., Raats, M.M. & Shepherd, R. (2008) Moral concerns and consumer choice of fresh and processed organic foods. *Journal of Applied Social Psychology*, 38(8), 2088–2107. Available from: https://doi.org/10.1111/j.1559-1816.2008.00382.x

Diamantopoulos, A., Schlegelmilch, B.B., Sinkovics, R.R. & Bohlen, G.M. (2003) Can socio-demographics still play a role in profiling green consumers? A review of the evidence and an empirical investigation. *Journal of Business Research*, 56(6), 465–480. Available from: https://doi.org/10.1016/S0148-2963(01)00241-7

Dilkes-Hoffman, L., Ashworth, P., Laycock, B., Pratt, S. & Lant, P. (2019) Public attitudes towards bioplastics–knowledge, perception and end-of-life management. *Resources, Conservation and Recycling*, 151, 104479. Available from: https://doi.org/10.1016/j.resconrec.2019.104479

ElHaffar, G., Durif, F. & Dubé, L. (2020) Towards closing the attitude-intention-behavior gap in green consumption: a narrative review of the literature and an overview of future research directions. *Journal of Cleaner Production*, 275, 122556. Available from: https://doi.org/10.1016/j.jclepro.2020.122556

Fantechi, T., Contini, C., Scozzafava, G. & Casini, L. (2022) Consumer preferences for wild game meat: evidence from a hybrid choice model on wild boar meat in Italy. *Agricultural and Food Economics*, 10(1), 23.

Fu, X. (2021) How habit moderates the commute mode decision process: integration of the theory of planned behavior and latent class choice model. *Transportation*, 48(5), 2681–2707. Available from: https://doi.org/10.1007/s11116-020-10144-6

Gall, S.C. & Thompson, R.C. (2015) The impact of debris on marine life. *Marine Pollution Bulletin*, 92, 170–179. Available from: https://doi.org/10.1016/j.marpolbul.2014.12.041

Gifford, R. & Nilsson, A. (2014) Personal and social factors that influence pro-environmental concern and behavior: a review. *International Journal of Psychology*, 49(3), 141–157. Available from: https://doi.org/10.1002/ijop.12034

Granato, G., Fischer, A.R. & van Trijp, H.C. (2022) The price of sustainability: how consumers trade-off conventional packaging benefits against sustainability. *Journal of Cleaner Production*, 365, 132739. Available from: https://doi.org/10.1016/j.jclepro.2022.132739

Grankvist, G. & Biel, A. (2001) The importance of beliefs and purchase criteria in the choice of eco-labeled food products. *Journal of Environmental Psychology*, 21(4), 405–410. Available from: https://doi.org/10.1006/jevp.2001.0234

Halonen, N., Pálvölgyi, P.S., Bassani, A., Fiorentini, C., Nair, R., Spigno, G. et al. (2020) Bio-based smart materials for food packaging and sensors–a review. *Frontiers in Materials*, 7, 82. Available from: https://doi.org/10.3389/fmats.2020.00082

Han, J.W., Ruiz-Garcia, L., Qian, J.P. & Yang, X.T. (2018) Food packaging: a comprehensive review and future trends. *Comprehensive Reviews in Food Science and Food Safety*, 17(4), 860–877. Available from: https://doi.org/10.1111/1541-4337.12343

Hensher, D.A., Rose, J.M. & Greene, W.H. (2015) Applied choice analysis. *Applied Choice Analysis*, 2014, 1–1188. Available from: https://doi.org/10.1007/9781316136232

Hermann, C., Rhein, S. & Sträter, K.F. (2022) Consumers' sustainability-related perception of and willingness-to-pay for food packaging alternatives. *Resources, Conservation and Recycling*, 181, 106219. Available from: https://doi.org/10.1016/j.resconrec.2022.106219

Jacobsen, L.F., Pedersen, S. & Thøgersen, J. (2022) Drivers of and barriers to consumers' plastic packaging waste avoidance and recycling–a systematic literature review. *Waste Management*, 141, 63–78. Available from: https://doi.org/10.1016/j.wasman.2022.01.021

Kędzia, G. & Turek, J. (2022) What hinders the development of a sustainable compostable packaging market? *European Journal of Sustainable Development*, 11(4), 180. Available from: https://doi.org/10.14207/ejsd.2022.v11n4p180

Kruger, J. & Dunning, D. (1999) Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, 77(6), 1121–1134.

Lancaster, K.J. (1966) A new approach to consumer theory. *Journal of Political Economy*, 74(2), 132–157.

Lehberger, M., Kleih, A. K., & Sparke, K. (2024). "Bio-based Plastic? Hm, I've Never Seen It!"—A mixed-methods investigation into consumer preferences for different packaging material of fresh apples and tomatoes. *Agribusiness*.

Lerro, M., Yeh, C.H., Klink-Lehmann, J., Vecchio, R., Hartmann, M. & Cembalo, L. (2021) The effect of moderating variables on consumer preferences for sustainable wines. *Food Quality and Preference*, 94, 104336.

Macena, M.W., Carvalho, R., Cruz-Lopes, L.P. & Guiné, R.P.F. (2021) Plastic food packaging: perceptions and attitudes of Portuguese consumers about environmental impact and recycling. *Sustainability*, 13(17), 9953. Available from: https://doi.org/10.3390/su13179953

Magnier, L., Schoormans, J. & Mugge, R. (2016) Judging a product by its cover: packaging sustainability and perceptions of quality in food products. *Food Quality and Preference*, 53, 132–142. Available from: https://doi.org/10.1016/j.foodqual.2016.06.006

Marshall, D.W. (1995) Introduction: food choice, the food consumer and food provisioning. In: *Food Choice and the Consumer*. New York City: Springer US, pp. 3–17.

Martinho, G., Pires, A., Portela, G. & Fonseca, M. (2015) Factors affecting consumers' choices concerning sustainable packaging during product purchase and recycling. *Resources, Conservation and Recycling*, 103, 58–68. Available from: https://doi.org/10.1016/j.resconrec.2015.07.012

McFadden, D. (1974) The measurement of urban travel demand. *Journal of Public Economics*, 3(4), 303–328.

Michaliszyn-Gabryś, B., Krupanek, J., Kalisz, M. & Smith, J. (2022) Challenges for sustainability in packaging of fresh vegetables in organic farming. *Sustainability*, 14(9), 5346. Available from: https://doi.org/10.3390/su14095346

Mitrano, D.M. & Wagner, M. (2022) A sustainable future for plastics considering material safety and preserved value. *Nature Reviews Materials*, 7(2), 71–73. Available from: https://doi.org/10.1038/s41578-021-00406-9

Montano, D.E. & Kasprzyk, D. (2015) Theory of reasoned action, theory of planned behavior, and the integrated behavioral model. *Health Behavior: Theory, Research and Practice*, 70(4), 231.

Morinval, A. & Averous, L. (2022) Systems based on biobased thermoplastics: from bioresources to biodegradable packaging applications. *Polymer Reviews*, 62(4), 653–721. Available from: https://doi.org/10.1080/15583724.2021.2012802

Nocella, G., Boecker, A., Hubbard, L. & Scarpa, R. (2012) Eliciting consumer preferences for certified animal-friendly foods: can elements of the theory of planned behavior improve choice experiment analysis? *Psychology & Marketing*, 29(11), 850–868. Available from: https://doi.org/10.1002/mar.20569

Nylund-Gibson, K., Grimm, R., Quirk, M. & Furlong, M. (2014) A latent transition mixture model using the three-step specification. *Structural Equation Modeling: A Multidisciplinary Journal*, 21(3), 439–454. Available from: https://doi.org/10.1080/10705511.2014.915375

Otto, S., Strenger, M., Maier-Nöth, A., & Schmid, M. (2021). Food packaging and sustainability-Consumer perception vs. correlated scientific facts: A review. *Journal of Cleaner Production*, 298, 126733.

Ortega, D.L., Wang, H.H., Wu, L. & Olynk, N.J. (2011) Modeling heterogeneity in consumer preferences for select food safety attributes in China. *Food Policy*, 36(2), 318–324. Available from: https://doi.org/10.1016/j.foodpol.2010.11.030

Paraschiv, G.I., Condrea, E. & Olteanu, V. (2020) Biodegradable and compostable products–essential components for the development of a sustainable bioeconomy. *Ovidius University Annals, Economic Sciences Series*, 20(1), 211–218.

Piracci, G., Boncinelli, F. & Casini, L. (2023) Investigating consumer preferences for sustainable packaging through a different behavioural approach: a random regret minimization application. *Environmental and Resource Economics*, 86(1), 1–27. Available from: https://doi.org/10.1007/s10640-023-00785-3

Prakash, G. & Pathak, P. (2017) Intention to buy eco-friendly packaged products among young consumers of India: a study on developing nation. *Journal of Cleaner Production*, 141, 385–393. Available from: https://doi.org/10.1016/j.jclepro.2016.09.116

Rabiu, M.K. & Jaeger-Erben, M. (2024) Reducing single-use plastic in everyday social practices: insights from a living lab experiment. *Resources, Conservation and Recycling*, 200, 107303.

Raimondo, M., Hamam, M., D'Amico, M. & Caracciolo, F. (2022) Plastic-free behavior of millennials: an application of the theory of planned behavior on drinking choices. *Waste Management*, 138, 253–261. Available from: https://doi.org/10.1016/j.wasman.2021.12.004

Rastegari Kopaei, H., Nooripoor, M., Karami, A., Petrescu-Mag, R.M. & Petrescu, D.C. (2021) Drivers of residents' home composting intention: integrating the theory of planned behavior, the norm activation model, and the moderating role of composting knowledge. *Sustainability*, 13(12), 6826. Available from: https://doi.org/10.3390/su13126826

Rivers, N., Shenstone-Harris, S. & Young, N. (2017) Using nudges to reduce waste? The case of Toronto's plastic bag levy. *Journal of Environmental Management*, 188, 153–162. Available from: https://doi.org/10.1016/j.jenvman.2016.12.009

Rokka, J. & Uusitalo, L. (2008) Preference for green packaging in consumer product choices–do consumers care? *International Journal of Consumer Studies*, 32(5), 516–525. Available from: https://doi.org/10.1111/j.1470-6431.2008.00710.x

Santos, V., Gomes, S. & Nogueira, M. (2021) Sustainable packaging: does eating organic really make a difference on product-packaging interaction? *Journal of Cleaner Production*, 304, 127066. Available from: https://doi.org/10.1016/j.jclepro.2021.127066

Shan, J., Li, J. & Xu, Z. (2019) Estimating ecological damage caused by green tides in the Yellow Sea: a choice experiment approach incorporating extended theory of planned behavior. *Ocean and Coastal Management*, 181, 104901. Available from: https://doi.org/10.1016/j.ocecoaman.2019.104901

Sharma, A. & Foropon, C. (2019) Green product attributes and green purchase behavior: a theory of planned behavior perspective with implications for circular economy. *Management Decision*, 57(4), 1018–1042. Available from: https://doi.org/10.1108/MD-10-2018-1092

Shepherd, R., Sparks, P. & Guthrie, C.A. (1995) The application of the theory of planned behaviour to consumer food choice. *ACR European Advances*.

Simmonds, G., Woods, A.T. & Spence, C. (2018) 'Show me the goods': assessing the effectiveness of transparent packaging vs. product imagery on product evaluation. *Food Quality and Preference*, 63, 18–27. Available from: https://doi.org/10.1016/j.foodqual.2017.07.015

Sridharan, S., Kumar, M., Bolan, N.S., Singh, L., Kumar, S., Kumar, R. et al. (2021) Are microplastics destabilizing the global network of terrestrial and aquatic ecosystem services? *Environmental Research*, 198, 111243. Available from: https://doi.org/10.1016/j.envres.2021.111243

Steenis, N.D., van der Lans, I.A., van Herpen, E. & van Trijp, H.C. (2018) Effects of sustainable design strategies on consumer preferences for redesigned packaging. *Journal of Cleaner Production*, 205, 854–865. Available from: https://doi.org/10.1016/j.jclepro.2018.09.137

Taneepanichskul, N., Purkiss, D. & Miodownik, M. (2022) A review of sorting and separating technologies suitable for compostable and biodegradable plastic packaging. *Frontiers in Sustainability*, 38, 901885. Available from: https://doi.org/10.3389/frsus.2022.901885

Taufik, D., Reinders, M.J., Molenveld, K. & Onwezen, M.C. (2020) The paradox between the environmental appeal of bio-based plastic packaging for consumers and their disposal behavior. *Science of the Total Environment*, 705, 135820. Available from: https://doi.org/10.1016/j.scitotenv.2019.135820

Testa, F., Di Iorio, V., Cerri, J. & Pretner, G. (2021) Five shades of plastic in food: which potentially circular packaging solutions are Italian consumers more sensitive to. *Resources, Conservation and Recycling*, 173, 105726. Available from: https://doi.org/10.1016/j.resconrec.2021.105726

Thøgersen, J. (2005) How may consumer policy empower consumers for sustainable lifestyles? *Journal of Consumer Policy*, 28(2), 143–177. Available from: https://doi.org/10.1007/s10603-005-2982-8

Tuwanky, A.A., Rohman, F. & Rofiq, A. (2018) Does green packaging matter as a business strategy? Exploring young consumers' consumption in an emerging market. *Problems and Perspectives in Management*, 16(2), 376–384. Available from: https://doi.org/10.21511/ppm.16(2).2018.34

Venturini, S. & Mehmetoglu, M. (2019) Plssem: a Stata package for structural equation modeling with partial least squares. *Journal of Statistical Software*, 88(8), 1–35. Available from: https://doi.org/10.18637/jss.v088.i08

Vermunt, J.K. (2010) Latent class modeling with covariates: two improved three-step approaches. *Political Analysis*, 18(4), 450–469. Available from: https://doi.org/10.1093/pan/mpq025

Walker, T.R. (2021) (micro) plastics and the UN sustainable development goals. *Current Opinion in Green and Sustainable Chemistry*, 30, 100497. Available from: https://doi.org/10.1016/j.cogsc.2021.100497

Weller, B.E., Bowen, N.K. & Faubert, S.J. (2020) Latent class analysis: a guide to best practice. *Journal of Black Psychology*, 46(4), 287–311. Available from: https://doi.org/10.1177/0095798420930932

Yadav, R. & Pathak, G.S. (2017) Determinants of consumers' green purchase behavior in a developing nation: applying and extending the theory of planned behavior. *Ecological Economics*, 134, 114–122. Available from: https://doi.org/10.1016/j.ecolecon.2016.12.019

Yangui, A., Costa-Font, M. & Gil, J.M. (2016) The effect of personality traits on consumers' preferences for extra virgin olive oil. *Food Quality and Preference*, 51, 27–38. Available from: https://doi.org/10.1016/j.foodqual.2016.02.012

Yeh, C.-H., Hartmann, M., Gorton, M., Tocco, B., Amilien, V. & Steinnes, K.K. (2021) Looking behind the choice of organic: a cross-country analysis applying integrated choice and latent variable models. *Appetite*, 167, 105591. Available from: https://doi.org/10.1016/j.appet.2021.105591

Yoo, H.I. (2020) lclogit2: an enhanced command to fit latent class conditional logit models. *The Stata Journal: Promoting Communications on Statistics and Stata*, 20(2), 405–425. Available from: https://doi.org/10.1177/1536867x20931003

Zwerina, K., Huber, J. & Kuhfeld, W. (1996) *A general method for constructing efficient choice designs*. Durham, NC: Fuqua School of Business, Duke Univesrsity, pp. 39–59.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Califano, G., Lombardi, A., Del Giudice, T., Caracciolo, F. & Cembalo, L. (2024) Bioplastics in the basket of Italians: A hybrid framework for understanding the adoption of bioplastic food packaging. *Australian Journal of Agricultural and Resource Economics*, 68, 826–846. Available from: https://doi.org/10.1111/1467-8489.12578