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Preferences for bio-textile sneakers: the interaction between social norms, environmental and social sustainability

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ABSTRACT

Bio-based materials incorporated into clothing, sourced from biomass, offer potential advantages by reducing reliance on fossil fuels and minimizing the environmental impact of the fashion sector. This paper explores the preferences of young adult consumers for sneakers featuring bio-based materials. Employing a discrete choice experiment integrated with attitudinal questions, we examine the relationship between the bio-based content in the upper, sustainability attributes such as certification and country of origin, and perceived social pressure. The presence of bio-based materials is generally perceived positively, indicating potential opportunities for market positioning and penetration. Interestingly, higher percentages of bio-based composition do not significantly enhance perceived sustainability. Environmental and social certifications are favorably received, with social certification exerting a marginally stronger influence. Social pressure seems to influence the preferences for a social certification with no significant effect on other product characteristics. Our findings offer valuable insights for manufacturers and stakeholders seeking to align with sustainable consumption trends in the fashion industry.

1. Introduction

Globally, 80 billion pieces of new clothing are purchased yearly (Bick et al., 2018), making the fashion sector one of the most significant in material consumption. The fashion industry is a major contributor to global carbon emissions, producing 3.3 billion tons of CO2, accounting for up to 10 % of global CO2 emissions. Moreover, the fashion industry is a major consumer of essential resources, using an estimated 79 trillion liters of water annually. It also relies heavily on chemicals and contributes to textile waste, generating over 92 million tons of waste each year (Niinimäki et al., 2020; Panhwar et al., 2024).

Calls to increase the sector's sustainability have recently been made (Chen et al., 2021; Koszewska, 2019). Agenda 2030 supports this goal, and the European Commission's Green Deal Investment Plan (European Commission, Directorate-General for Research and Innovation, 2018) includes initiatives to make EU products more sustainable throughout their life cycle. An encouraging approach in this sense involves using renewable biological resources from terrestrial and aquatic sources to produce food, materials, and energy (European Commission, 2018). Central to this concept are biobased products, which are defined as products either entirely or partially derived from biomass, such as plants, trees, or animals (CEN, European Standardization Institute, 2014). Biobased products are not always and inherently more sustainable than their fossil-based counterparts (Rosenboom et al., 2022), but they can offer numerous environmental advantages, including reduced reliance on fossil fuels, decreased greenhouse gas emissions, lower toxicity, and the potential to be biodegradable or compostable (European Commission, 2018).

In the fashion industry, biobased products manifest primarily as bio-based textiles. Market penetration of this product has been investigated as a potential intervention on the demand side to reduce the environmental impact of the fashion sector. In this regard, understanding the preferences of potential consumers is a determinant for developing such strategies.

This paper investigates how the presence of biobased textiles in the garment affects young consumers' clothing preferences. Our interest is specifically in the trade-offs between this characteristic and sustainability-related attributes, such as country of production or environmental labeling. We also contextualize this relation in the presence of perceived social pressure. To do so, we conduct a large discrete choice experiment (DCE) integrated with attitudinal questions, including four questions related to social pressure, a core component of the well-

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established Theory of Planned Behavior (TPB) (Ajzen, 1991), which has been widely used to analyze green purchasing behavior (Ramadhanti et al., 2024). We focus our analysis on young adults, defined as people aged between 18 and 34 years interval (Vespa, 2017), asking them to choose between different sneaker shoes made of biobased textiles. We chose the sneaker market because it represents a significant market segment, with an estimated value of approximately USD 84 billion and a projected compound annual growth rate of 7.2 % between 2021 and 2027 (Fritz et al., 2024). Furthermore, sneakers are widely recognized by both Millennials and Generation Z as a true status symbol, with the purchase of specific models or brands serving as a way to express personal taste and social status (Slaton and Pookulangara, 2024). They are valued not only for their functionality but also as a means of personal communication (Denny, 2020). This symbolic nature makes sneakers particularly relevant for exploring dynamics related to sustainability in fashion consumption among young adults. Analyzing a product perceived by consumers as essential for their identity and status provides an opportunity to understand to what extent people are willing to accept sustainability attributes while maintaining the product's aesthetic and social appeal.

Literature has indicated that young adults are increasingly socially and environmentally conscious, displaying a heightened awareness of the impact of their consumption choices, and tend to incorporate sustainability considerations into their purchasing decisions (Diddi et al., 2019; Chaturvedi et al., 2020; Notaro and Paletto, 2021). However, it remains unclear how various product characteristics, which may represent different aspects of sustainability, are assessed individually and in relation to one another. This information is essential for the fashion industry because the young generation represents a large portion of the present and future market demand. For example, people belonging to generation Z, who make up a substantial proportion of our sample, are expected to be the largest consumer segment worldwide by 2030 (Kim et al., 2020). Our work aims to contribute to this line of research by being the first to investigate the trade-offs among multiple sustainability attributes and how these interact to influence consumer preferences. Differently from recent research (Diddi et al., 2019; Chaturvedi et al., 2020; Notaro and Paletto, 2021), our focus is not just on the environmental sphere of sustainability but also on how young adult potential purchasers evaluate the social aspect and to what extent these two are traded off. Environmental and social dimensions are frequently communicated to consumers through product certifications, which serve as visible signals of a company's commitment to sustainability. Environmental certifications generally focus on minimizing ecological impacts during production, while social certifications aim to ensure fair labor practices and workers' rights. Vásquez-Lavín et al. (2020) highlight how consumers may evaluate these attributes differently, depending on the nature of the perceived benefits. Despite the importance of both environmental and social aspects as purchasing drivers in sustainable consumption, there remains a paucity of evidence on the different importance for consumers and the influence that social pressure can have on these two aspects. This last aspect represents the main novelty of our approach.

From a methodological standpoint, we analyze the data coming from the DCE with the integrated choice and latent class model (ICLV) pioneered by Ben-Akiva et al. (2002) and also known as hybrid choice model. This specification allows the researcher to model a psychological construct or an attitude as a latent variable depending on socio-economic characteristics and a random component whose distribution is assumed to be known.

The rest of the paper is organized as follows. The second section reviews the related literature, while in the third section, we present our methodology. In the fourth section, we introduce the results, and in the final section, we discuss them.

2. Literature review

In recent years, a growing body of literature has investigated consumers' preferences for a biobased product. A review conducted by Ruf et al. (2022) revealed that studies on consumer preferences have spanned diverse sectors, including bottles, packaging, apparel, consumer goods, construction materials, and horticultural products. Recently, more attention has focused on fashion. These studies have investigated consumers' willingness to pay (WTP) for biobased clothing and delved into the primary determinants of their purchasing decisions (Sadiq et al., 2021; Brand and Rausch, 2021; Colasante & D'Adamo, 2021; Notaro et al., 2022; Notaro and Paletto, 2021; Klein et al., 2020). Biobased material composition has generally been identified as an attribute positively influencing consumers' purchasing decisions (Notaro et al., 2022; Colasante and D'Adamo, 2021; Notaro and Paletto, 2021). Notaro and Paletto (2021) find that consumers may also be willing to pay a premium price for bio-textile products, even though pricing remains a significant barrier to sustainable consumer choices. Scherer et al. (2018) observed a marked interest among German consumers in running shoes featuring bio-based plastic soles. Conversely, Friedrich (2021) found that the advantages of plastics-based materials in an outdoor jacket outweighed the sustainability benefits of bioplastics. Rausch et al. (2021) emphasized that traditional apparel attributes like fit and comfort often overshadow sustainable features. Nonetheless, specific sustainable apparel attributes, such as garment durability, fair wages and working conditions, and environmentally friendly production processes, have been identified as relevant.

Some sociodemographic and attitudinal factors have been identified as positively influencing consumers' choices to purchase sustainable apparel. These factors include the level of environmental knowledge (Sadiq et al., 2021; Brand and Raush, 2021), consumer values (Klein et al., 2020), purchase intention, subjective norms, control of perceived costs, and other demographic characteristics such as age and gender (Notaro et al., 2022). Additionally, factors such as conspicuous consumption, environmental concern, perceived consumer effectiveness, and trust in sustainable clothing brands have also been shown to positively influence the purchase of sustainable clothing (Apaolaza et al., 2022).

Within the broader literature on biobased products, some studies have examined the role of age, yielding mixed results. While younger consumers have demonstrated a heightened interest in purchasing biobased products (Friedrich, 2021), they also appear less aware of them (Notaro and Paletto, 2021). Interestingly, a younger demographic has been linked to a more profound understanding of the characteristics of biobased materials (Koutsimanis et al., 2012), yet they seem less willing to pay a premium for such products (Russo et al., 2019). However, there is no evidence whether the same results can be extended to the fashion industry.

Recent reviews have highlighted that general consumer understanding of the term "biobased" is limited. Many are uncertain about its definition, and misconceptions about the properties of biobased products are not uncommon (Ruf et al., 2022; Findrik and Meixner, 2023). Most findings indicate a need for more comprehensive knowledge concerning the material's base, biodegradability, disposal methods, and whether consumers consciously engage with bioplastics. This is particularly interesting, considering biobased products do not inherently guarantee greater sustainability. The potential benefits of using renewable resources, such as reduced carbon emissions, can be offset by other product lifecycle considerations (Rosenboom et al., 2022). Given this context, it becomes crucial to understand whether consumers associate biobased products with higher product sustainability. In this regard, how this characteristic of a clothing product is traded off with other sustainability-linked features, such as the country of origin or the compliance with specific standards in the production chain, remains to be explored. Often, once a buyer identifies a product as sustainable based on one feature, they may overlook additional aspects that further

contribute to its sustainability. Our study addresses this gap by being the first to explicitly investigate how multiple sustainability-related attributes, interact and influence consumer preferences. By examining the trade-offs between these features, we provide an understanding of how consumers prioritize different dimensions of sustainability in their purchasing decisions.

Such "warm glow" mechanism can be mediated by social pressure, which has been demonstrated to be a potential determinant of sustainable clothing purchasing behavior (Kumar et al., 2022; Davis and Dabas, 2021; Kim and Seock, 2019; Nguyen et al., 2019; Han and Stoel, 2016; Varshneya et al., 2017; Jung et al., 2020). However, the specific role of social pressure remains complex. While it has demonstrated mixed effects on attitudes and purchasing intentions for organic clothing (Varshneya et al., 2017), other research indicates that social pressure might not significantly sway the acquisition of sustainable garments (Kumar et al., 2022; Davis and Dabas, 2021; Jung et al., 2020). It is thus important to gain more insight into the role that social pressure plays in sustainable clothing purchases. For this reason, we are also presenting a methodologically sound approach to explore the complex relationship between the intention to purchase a garment seen as sustainable and the associated social pressure.

3. Materials and methods

3.1. Survey design and administration

The data were collected through a questionnaire designed following accepted guidelines for DCE (Johnston et al., 2017; Riera et al., 2012) and consisting of four sections. The first section, instrumental in introducing the hypothetical DCE scenario, presents the questionnaire's aim and asks whether the respondent has ever purchased a product made of biobased material. To ensure respondents correctly understood the product, we first provided a brief explanation of biobased materials, including the official definition by the European Committee for Standardization (CEN), which describes them as materials derived from biomass sources such as agricultural residues or food industry by-products. Practical examples were included, such as bioplastic utensils made from avocado seeds and fabrics obtained from orange pulp residues. We then clarified that such materials can also be used in the production of sneakers, specifically in the upper part of the shoe.

The second section contains the discrete choice experiment. This section is introduced by the description of a hypothetical scenario in which respondent needs to contextualize their choices, defined as follows:

> "Imagine now that you have to decide whether or not to buy a pair of sneakers.
>
> We will now ask you to choose between 3 alternatives. The first two alternatives each present a pair of sneakers, while the third option is to purchase nothing. For each of the sneakers presented in the alternatives, the selling price, the percentage of bio textiles in the upper, the country of origin, and the presence of an environmental or social sustainability certification will be reported. Please consider that the shoes are identical except for the characteristics presented above. We ask you to choose which of the three alternatives is your favorite."

Afterward, respondents were given a brief but more detailed description of the sneakers' attributes and levels (Table 1). The attributes included in the choice card were derived from a literature review and 17 one-on-one interviews conducted with young adults, during which they were asked about the factors they consider important when purchasing a pair of sneakers.

Product durability, fabrics used (Hugo and van Aardt, 2012), and country of origin (Hsu et al., 2017) were found to be important in purchase valuations. Jegethesan et al. (2012) also pose the accent also on a set of what they call "ethical attributes" such as organic or fair-trade certification. Since we wanted to avoid investigating the effect of a specific existence certification, we included a generic social or environmental certification as an attribute of sneakers (see Table 1). Moreover, besides the obvious cost attribute, we included in the choice task the percentage of bio-textile in the shoe upper and the country of origin. Concerning the former attribute, three countries were selected: i) Italy, since the survey was conducted in this country; ii) the USA, since many sneakers' brands and models are imported from there; and iii) Vietnam, as a country where many of the shoes that are bought in Europe are made from. The experimental design was obtained through a D-efficient approach with non-informative (zero) priors (Mariel et al., 2021). To select the price levels, we compare the cost of several sneakers produced with alternative fabrics to traditional leather (Table 1).[1]

Table 1
Description of the attributes included in the choice task.

Attribute	Description	Levels
Bio – Textile	Percentage of Bio-textile included in the fabric of the upper of the shoes.	• 20 % • 50 % •100 %
Country of production	Country where the sneakers are made, the information is a legal requirement.	•Italy •USA •Vietnam
Certification	Certifies whether the product meets specific requirements	•**None** •**Environmental**: Certifies minimization of environmental impact in production processes •**Social**: Ensures that products have been manufactured respecting workers' rights
Price	The purchase price for the sneakers	•80€ •120€ •160€ •200€

Each respondent was presented with a cheap talk to mitigate hypothetical bias (Mariel et al., 2021). Then we showed twelve choice tasks which can be considered the maximum acceptable trade-off between collecting as much information as possible and avoiding excessive burden (Scarpa et al., 2011).[2] Each choice task consisted of a choice between two different models of sneakers made from bio-textiles and an opt-out question that expressed the preference not to make a purchase (Fig. 1). The choice not to include an image was driven by the fact that visualizing the item could bring more people to opt out for an image-related preference.

The third section was dedicated to collecting attitudinal questions, including four indicators related to social pressure within the Theory of Planned Behavior (see Table 2), adapted for our application from Paul et al. (2016). The last section asked for sociodemographic characteristics.

The survey was administered to young Italian adults (18–34 years old) between September 2020 and January 2021; difficulties in performing face-to-face interviews due to pandemic restrictions led us to choose the online mode. Before the actual field period, a pretest with 30 respondents was conducted to verify the consistency and clarity. Following this, a snowball sampling technique, chosen for its networking capabilities and flexibility (Parker et al., 2019), was employed to recruit respondents. This involved disseminating the survey

[1] Although the attributes were clearly defined and described independently in the survey, it is possible that some respondents perceived a partial overlap, for instance, associating certification with the presence of sustainable materials. Even if present, this would be more likely to increase the variance of responses rather than introduce bias, making our estimates more conservative overall.

[2] We note that presenting 12 choice tasks may introduce some degree of respondent fatigue, although this number is within the range generally considered acceptable in the literature.

	Sneakers A	Sneakers B	
Bio-Textile	20%	50%	Do not Purchase
Country of production	Italy	Vietnam	
Certification	None	Social	
Price	120€	160€	

Which option would you choose?

- ❑ Sneakers A
- ❑ Sneakers B
- ❑ Do not purchase

Fig. 1. Example of choice task presented to respondents.

Table 2
Indicators of social pressure. Each respondent was asked to rate the level of agreement with the statements on a 1 (strongly disagree) to 5 (strongly agree) Likert scale. Items were adapted from Paul et al. (2016).

SP Indicator 1 (SP1)	People important to me, such as family members or close friends, would support my purchases of sneakers made from bio-textiles.
SP Indicator 2 (SP2)	People important to me, such as family members or close friends, would support my purchases of sneakers produced by respecting workers' rights.
SP Indicator 3 (SP3)	People whose opinions I value would support my purchases of sneakers made from bio-textiles.
SP Indicator 4 (SP4)	People whose opinions I value would support my purchases of sneakers produced by respecting workers' rights.

online through social media and email invitations and encouraging them to share the survey link with their peers. Despite the sampling method might introduce some bias, the high number of participants mitigates this issue, as the regression analyses rest on asymptotic efficiency (Wooldridge, 2015). The limitations of this approach are discussed in the last section.

3.2. The integrated choice latent variable model

In our study, we aimed to explicitly account for the role of social pressure in shaping individual preferences. To do so, we required a modeling approach capable of integrating attitudinal information directly into the utility function. While Latent Class Models can be useful for uncovering discrete segments within a population based on preference heterogeneity, they are less suited for explicitly modeling the influence of continuous, theory-driven psychological constructs. The Integrated Choice and Latent Variable (ICLV) model, also known as hybrid choice model, by contrast, allows for the simultaneous estimation of both choice behavior and latent attitudinal variables. This makes it particularly appropriate in contexts where constructs such as perceived social norms are hypothesized to affect decision-making and can be measured through multiple observed indicators.

The theory that stands behind ICLV has been developed for more than twenty years and has been primarily applied in transport studies (Ben-Akiva et al., 2002). Their application has since expanded to include environmental economics (Hoyos et al., 2015) and many other fields, such as energy (Dekker et al., 2016) and health economics (Kløjgaard and Hess, 2014). For a comprehensive discussion (also on the limitation of the approach), the interested reader is referred to (Abou-Zeid and

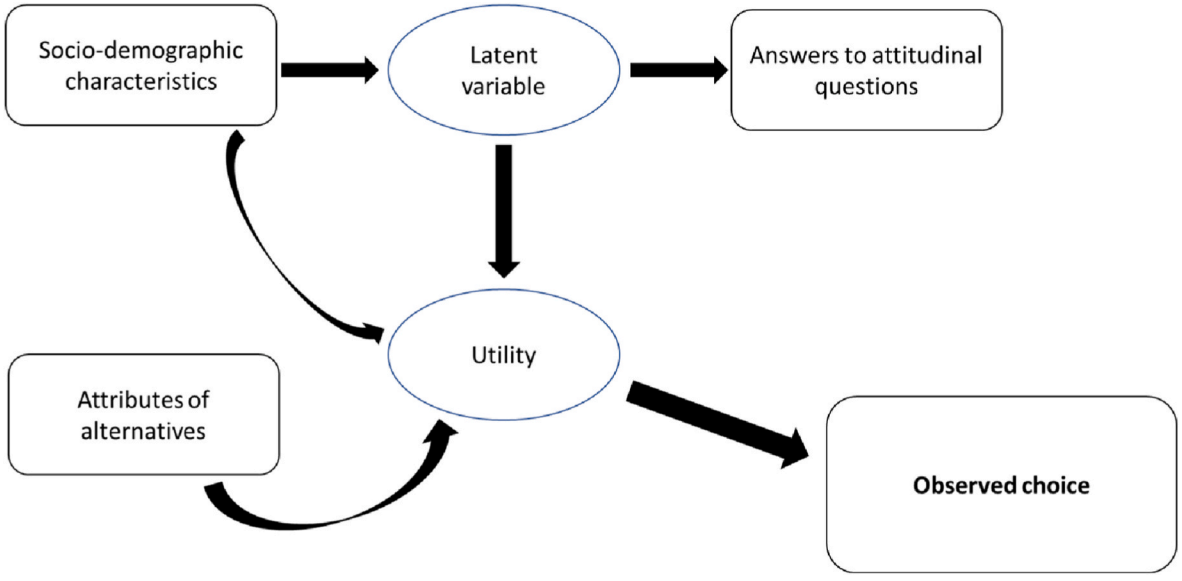

Fig. 2. The general framework of an ICLV.

Ben-Akiva, 2014; Ben-Akiva et al., 2002; Chorus and Kroesen, 2014). Fig. 2 illustrates the general framework of an ICLV.

At its essence, ICLV requires the specification of three different structural equations, one defining the choice model component while the other two explaining the likelihood of the latent variable model. The first component, namely the choice model structural equation, puts its roots in the ground of the random utility framework (McFadden, 1974). In a standard random utility model, the utility of a respondent n choosing the option i among J discrete alternatives are assumed to be made of two components, one deterministic and observable part V_{ni} and one random variable component ε_{ni} representing the non-observable determinant of human behavior so that we obtain:

$$U_{ni} = V_{ni} + \varepsilon_{ni} \quad \text{Eq. (1)}$$

The deterministic component V_{ni} depends on the explanatory variables x_{ni} plus an alternative specific constant ASC_i. In our application, like in most cases, observable utility is assumed to be linear in the covariates. If ε_{ni} is assumed to follow a Gumbel distribution, the choice probability for the alternative i takes the logit form:

$$P_{ni} = \frac{e^{ASC_i + \beta X_{ni}}}{\sum_{j=1}^{J} e^{ASC_j + \beta X_{nj}}} \quad \text{Eq. (2)}$$

The second structural equation characterizing the model is the one that defines the perceived social pressure as a latent variable (SP) and is given by:

$$SP_n = g\left(Z_n, \gamma_n\right) + \omega_n \quad \text{Eq. (3)}$$

Where $g\left(Z_n, \gamma_n\right)$ is the deterministic component of the structural equation and $g(\cdot)$ is the functional form, here assumed to be linear, that links a vector of sociodemographic variables Z_n and the correspondent vector of parameters γ_n to the latent variable. A random component ω_n is added to the deterministic one and is assumed to be normally distributed with zero means. Equation (3) makes it clear that the latent variable is influenced by the personal characteristics of the respondent.

The final component of the model is the "measurement model" that links the answers to the attitudinal question to the social pressure latent variable. The measurement model, as mentioned, treats answers to attitudinal questions as dependent variables using the latent variable SP as an explanatory variable. Although the attitudinal indicators were measured on Likert scales, the question wording used in the questionnaire was intended to elicit a perception of social pressure as a continuous psychological intensity, rather than discrete attitudinal categories. This justifies the use of a continuous structure for the latent variable. Formally:

$$I_{kn} = \delta_k SP_n + \nu_n \quad \text{Eq. (4)}$$

Where I_{kn} is the answer to the k-th attitudinal question given by respondent n, δ_k is a parameter to be estimated that measures the impact of the latent variable on the Likert score chosen by the respondent and ν_n is a normal distributed error term. Equation (4) completes the framework of the structural model.

To allow the latent variable to enter the utility function, SN_n is interacted with the covariates of the choice model via a λ coefficient. The interaction coefficient can readily be interpreted as the effect of the perceived social norm on the utility carried by the attribute with which it is interacted. Finally, the joint log-likelihood function of the ICLV model is given by:

$$LL\left(\beta, \gamma, \delta, \tau, \lambda\right) = \sum_{n=1}^{N} \ln \int_{\omega} L(y_n | \beta, \gamma, \lambda) \cdot L(I_n | \delta, \tau)\, g(\omega)\, d(\omega) \quad \text{Eq. (5)}$$

Where $g(\omega)$ is the density function of the latent variable's error component. The joint log-likelihood comes from integrating the likelihood of the choice model and the likelihood of the measurement model. Moreover, it is possible to extend the model in Eq. (5) to allow for random taste variation specifying a certain distribution for the parameters β. In other words, some (or all) of the coefficients yielding the marginal utility of an attribute can be treated as a random variable. Let $\beta \sim N\left(\beta \mid \Omega_\beta\right)$, then Eq. (5) becomes:

$$LL\left(\beta, \gamma, \delta, \tau, \lambda\right) = \sum_{n=1}^{N} \ln \int_{\beta} \int_{\omega} L(y_n | \beta, \gamma, \lambda) \cdot L(I_n | \delta, \tau)\, N\left(\beta \mid \Omega_\beta\right)\, g(\omega)\, d(\beta)\, d(\omega) \quad \text{Eq. (6)}$$

The above integral's dimension is determined by the number of parameters specified as random variables and the number of latent variables. Including random components is useful to allow for different substitution pattern between alternatives and to capture the source of heterogeneity in the preferences (Train, 2009).

The integral in equation (6) does not take a closed form, so the parameters must be estimated via simulated maximum likelihood (McFadden and Train, 2000). The estimation of the parameters has been done simultaneously using the R-package Apollo (Hess and Palma, 2019).

4. Results

After data cleaning, excluding all incomplete answers, protest responses, and respondents older than 34 or younger than 18, we reached a final sample of 472 individuals, resulting in 5664 choice observations. Table 3 shows the summary statistics of the sample.

Table 3
Summary statistics of the sample.

Variable	Mean (sample)	Mean (population)	std.dev (sample)	median	min	max
Age	25.43	26.31	2.99	25	18	34
Gender (Female = 1)	0.57	0.49	–	1	0	1
Purchased a biobased product in the past (yes = 1)	0.47	–	–	0	0	1
Low income (<20,000)	0.09	–	–	0	0	1
middle income (20,000€-40,000€)	0.76	–	–	1	0	1
high income (>40,000)	0.15	–	–	0	0	1
SP1	3.81	–	1.79	4	1	5
SP2	3.9	–	1.76	4	1	5
SP3	3.86	–	1.74	4	1	5
SP4	3.89	–	1.73	4	1	5

Population means refer to 2020 national statistics where available. For income classes, disaggregated data by age group are not publicly available. The national average disposable income for people under 35 years per capita in 2020 was €27,201 (source: ISTAT).

The mean age of respondents in the sample was 25.43 years, with a median of 25. Approximately 57 % of participants identified as female. The sample mean age is very close to the population mean (26.31 years), while females are slightly over-represented compared to the general population (49 %). Regarding household income, 15 % of respondents reported earnings exceeding €40,000 annually, while 9 % had incomes below €20,000. The majority, 76 %, fell within the intermediate income range of €20,000–€40,000, aligning closely with the Italian national average (http://dati.istat.it/Index.aspx). Additionally, 47 % of respondents indicated prior experience purchasing biobased products, such as t-shirts made from bamboo, reusable straws, or toothbrushes. Responses to the attitudinal measures on social pressure, as shown in Table 2, were consistently high across all four items, indicating a strong perception of social pressure related to purchasing decisions.

Table 4 presents the results of the Integrated Choice and Latent Variable (ICLV) model, which includes both the estimated choice model parameters and the interactions with the latent variable. All parameters, except the cost parameter, were assumed to follow a normal distribution, with separate estimates provided for their means and standard deviations. On average, respondents exhibited a preference for sneakers with an upper composition of 50 % bio-textile compared to the baseline level of 20 %. Similarly, preferences were positive for uppers made entirely of biobased material (100 %). However, there was no statistically significant difference between preferences for the 50 % and 100 % bio-textile compositions, suggesting that increasing the proportion of biobased material beyond 50 % does not further enhance preferences.

Table 4
Estimation results for the ICLV - random parameters model. The random parameters have been assumed to follow a normal distribution. The model has been estimated with maximum simulated likelihood using 5000 pseudo-Monte Carlo random draws. The baseline levels were fixed to zero during estimation.

Parameter	Estimate	Rob SE	Rob t
Alternative specific constant (ASC)	1.93	0.12	15.7
Random parameters mean			
20 % bio-textile	baseline level		
50 % bio-textile	0.54	0.04	13.27
100 % bio-textile	0.59	0.05	11.95
Production in Italy	baseline level		
Production in Vietnam	−0.44	0.04	9.92
Production in the US	−0.31	0.04	7.61
No certification	baseline level		
Environmental certification	0.38	0.05	7.08
Social certification	0.48	0.05	10.56
Cost	−0.007	0.001	8.425
Random parameters standard deviation			
50 % bio-textile	0.01	0.28	0.02
100 % bio-textile	0.19	0.27	0.7
Production in Vietnam	0.19	0.18	1.1
Production in the US	0.47	0.06	7.23
Environmental certification	0.34	0.11	3.17
Social certification	0.12	0.31	0.4
Latent variable interaction terms			
LV x 50 % bio-textile	0.01	0.04	0.13
LV x 100 % bio-textile	−0.05	0.04	1.21
LV x Production in Vietnam	−0.06	0.05	1.27
LV x Production in the US	−0.06	0.05	1.3
LV x Environmental certification	0.06	0.05	1.29
LV x Social certification	0.12	0.04	2.77
Latent variable calibration			
Gender (female)	0.1	0.08	2.29
Previous purchasing experience	0.21	0.08	2.56
Income > 40k €	−0.2	0.09	2.16
Measurement model			
SP1	0.61	0.03	19.19
SP2	0.64	0.03	23.52
SP3	0.7	0.03	25.37
SP4	0.68	0.03	24.74
Model characteristics			
Likelihood at convergence	−6457.7		
AIC	12977.4		
Observations	5664		

In terms of the product's country of origin, the coefficients for "production in Vietnam" and "production in the USA" were significantly negative, indicating that respondents preferred sneakers produced in Italy. Regarding certifications, both social and environmental certifications had a positive impact on the probability of purchasing the sneakers, although the effect was stronger for social certification. The cost parameter was highly significant and negative, consistent with economic theory, as respondents showed sensitivity to price increases. The alternative-specific constants for the hypothetical options were positive and significant, indicating that respondents, on average, preferred purchasing sneakers over opting out.

Analysis of the standard deviations of the random parameters provided insights into heterogeneity in preferences. The standard deviation associated with the 50 % bio-textile parameter was not significant (t-value = 0.78), indicating homogeneous preferences for this attribute across respondents. Similarly, the standard deviation for the 100 % bio-textile level was not significant (t-value = 0.7), suggesting stability in preferences for bio-textile composition. Preferences for Italian sneakers compared to those made in Vietnam showed no significant heterogeneity. However, preferences for sneakers produced in the United States displayed significant heterogeneity, with an estimated normal distribution (mean = −0.31, standard deviation = 0.47). This distribution suggests that approximately 25 % of respondents derived positive utility from U.S.-made sneakers, preferring them over Italian alternatives.

Preferences for social certification showed no significant standard error, indicating consistent positive preferences for this attribute. In contrast, the standard error for environmental certification was significant, reflecting heterogeneity in responses. The normal distribution estimated indicates that a smaller portion of the respondents (around 12 %) seems to be influenced negatively by the presence of an environmental certification. We will discuss these results in the next section.

We now look at coefficients of interaction terms between the latent variable and each attribute. Among these interactions, only the coefficient for the interaction between social pressure and social certification was statistically significant. This result indicates that higher levels of perceived social pressure positively influenced preferences for sneakers with social certification, while other attributes were not significantly affected by social pressure.

Regarding the structural equations defining the latent variable, we show the parameters that resulted in a significant effect on the social pressure latent variable.[3] Identifying as female and having prior experience purchasing biobased products were associated with higher levels of perceived social pressure to purchase sneakers made from bio-textile materials. In contrast, respondents from households with annual incomes exceeding €40,000 reported lower levels of perceived social pressure. Finally, the measurement model estimates confirm that the social pressure latent variable is a significant predictor of responses to each item in Table 2, further validating its role in shaping consumer attitudes.

5. Discussions

We found that participants in the administered choice experiment demonstrated interest in purchasing biobased sneakers. On average, respondents preferred to buy sneakers with an upper composed of at

[3] During the analysis multiple definition of the structural models were specified. The procedure of selection of the variables was based on stepwise process iteratively deleting the non-significant ones from the main specifications (results are available on request to the corresponding author).

least 20 % biobased material instead of not purchasing them. Furthermore, they were more likely to prefer shoes made with at least 50 % biobased material, while a significant difference in the utility increase between the 50 % and 100 % biobased material levels was not found. Results also show that preferences were homogeneous in this sense, meaning that almost all respondents positively evaluated sneakers with the upper composed of biobased material. This result suggests primarily that the presence of biobased material is generally perceived as a positive feature. Although this attribute does not generally ensure greater sustainability of the garment itself, potential buyers seem to perceive it as an indicator of such a characteristic.

Interestingly, we found no significant differences in preferences between an upper composed entirely of bio-textile (100 %) and one that is only partially composed of bio-textile (50 %). This satiation effect regarding upper composition may be linked to diminishing returns in moral satisfaction. This concept suggests that individuals may choose to purchase products with sustainable features to fulfill their moral obligations (Kahneman and Knetsch, 1992). The presence of sustainability improvement in a product may be sufficient to satisfy an individual's moral goals, regardless of the degree of improvement (Steenis et al., 2018). The latent variable expressing social pressure has not been found to be significant when interacted with the level of biobased material. This further confirms that the perception of sustainability already seems to be contained in the attribute itself.

The analysis of the origin attributes indicates that, on average, respondents tended to prefer purchasing sneakers manufactured in Italy. This outcome is consistent with the theory of consumer ethnocentrism, according to which consumers, especially in developed countries, tend to prefer domestically produced goods (Sharma et al., 1994). Moreover, consumers tend to prefer to purchase a product made domestically to help support local communities and the domestic economy (Ha-Brookshire, 2012). Italians might be inclined to acquire domestically produced goods primarily due to the perceived high quality associated with such products (Cappelli et al., 2019). The disutility of respondents to purchase shoes produced in Vietnam is likely to be associated with the prevalent perception of inadequate working conditions and violations of labor rights in developing countries (Majumdar et al., 2020). On average, the respondents also exhibited disutility for sneakers produced in the USA. In this case, preferences were heterogeneous, with an estimated 25 % of the distribution of preferences with a positive attitude toward this type of product. This heterogeneity can be attributed to the appeal of USA culture, which may result in a preference for these products among certain individuals.

Respondents preferred certified shoes, aligning with prior research that demonstrated a higher preferences for certified products than non-certified ones (Janβen and Langen, 2017; Silva et al., 2017). Such findings further reinforce the evidence that young adults have a strong ethical and environmental consciousness (Pradeep and Pradeep, 2023). However, a stronger preference was observed for social certification over environmental certification. This contrasts with findings from other sectors where environmental attributes are generally more valued (e.g., Lavín et al., 2020). In the context of sneakers, ethical concerns related to workers' rights may resonate more strongly with young consumers, possibly due to a stronger emotional response to issues like child labor compared to environmental concerns (Williams and Hodges, 2022). Conversely, environmental certification elicited a heterogeneous response, with some respondents even perceiving it as a disutility. Again, the sneakers were probably already perceived as environmentally friendly because of the presence of biobased material, leading to the environmental certification being potentially valued as redundant by some respondents. This finding is consistent with the idea that consumers may take certain aspects - such as environmental sustainability - for granted when advertising another attribute, such as biobased material composition. Another potential reason is that young adults may prioritize social over environmental responsibility due to a stronger emotional response to issues like child labor compared to environmental concerns (Williams and Hodges, 2022). Furthermore, as suggested by the study by Fani et al., 2022, although young adults are attentive to product sustainability, they often do not appreciate when a product shows evident sustainability cues. This is due to the fear of how they might be perceived by others, as people who purchase sustainable products are often judged as unconventional. Our findings also suggest a significant influence of social pressure on the choice of socially certified shoes. Notably, the interaction term with the latent variable turns out to be significant only for social and not environmental certification. This aspect leads us to infer that social pressure may have a character more related to the social sphere of a product's sustainability. However, this conclusion needs further research support to be confirmed. Alternatively, another hypothesis that could be investigated more in future development is the idea that an individual's perception of social pressure to buy sustainable shoes increases the value they place on social certification.

6. Conclusions

The adoption of bio-based products has yet to reach significant levels, and additional research is needed to deepen the understanding of the factors that can influence the choice of consumers to buy these products, especially regarding psychological and psychographic aspects influencing consumer responses (Morone et al., 2021; Ruf et al., 2022).

Our results suggest that an article of clothing, such as a pair of sneakers, is valued differently based on characteristics that indicate different spheres of sustainability by young adults. Research has shown that people, and even young adults, value a clothing product in terms of the environmental impact of production processes and respect for workers' rights. Building upon this literature, we provide manufacturers and other stakeholders with important information. First, our results show that the presence of biobased material in the composition of sneakers is, on average, considered a positive factor. This result is interesting since the presence of such a material in the composition of a garment does not in itself ensure a lower environmental impact of the product. To achieve sustainability objectives such as SDGs, it is essential that buyers understand this aspect. In this regard, certification could play an increasingly important role in guaranteeing authentic sustainability standards.

We did not find significant differences in preferences for sneakers composed entirely of biobased material with respect to sneakers composed of half the same material. The presence of biobased material in the upper would seem to communicate greater sustainability of the product, which buyers prefer, but not increasingly with respect to high percentages. The results also show that there are market segments that attribute greater value to sneakers made entirely of biobased material. In this sense, this study could serve as a starting point for positioning and penetration strategies in a rapidly growing market. Therefore, businesses should strategically incorporate bio textiles into their products, considering that while consumers favor these materials, there is no marked preference for products made entirely from them. A balanced approach could optimize the perceived product value.

The presence of an environmental or social certification is, on average, considered a positive feature, with the latter being considered slightly more important, although this can be explained by the fact that the perceived environmental sustainability of the product is embedded in the composition of the upper. Potentially for the same reason, perceived social pressure has not been found to have an impact on the preferences for environmental certification while a positive one on the preferences for certification of fair working conditions in the production. We can summarize these results by claiming that the communicative role of certification is expressed to a greater and more effective extent when the product's characteristics do not directly communicate sustainability. This is of great interest to clothing market players since effectively communicating the sustainability of their products to young adults may be possible through a different route than obtaining a

certification. To what extent this is possible should be the object of further research.

Finally, we acknowledge the presence of some limitations of our approach. The sampling strategy used does not guarantee complete representativeness of the target population, which must then be assessed by considering its demographic composition. In this regard, our sample appears to be in line with the demographics in the reference population except for the level of education. However, whether and how the level of education can be related to the variables investigated remains unclear. We also recognize that the sample size is relatively modest. Nonetheless, it is comparable to those employed in similar discrete choice experiments exploring consumer preferences (Naughton et al., 2025; Notaro et al., 2022). Moreover, the price levels used to describe sneakers in the choice experiment, that start from a minimum of 80€. Although in line with retail prices at the time of questionnaire administration, this value remains relatively high. Thus, we do not observe how potential buyers may react to lower ranges of price changes, which is grounds for interesting future research. Finally, a further limitation of this study is the exclusion of attributes such as brand reputation, design, and color, which are known to significantly influence sneaker purchases. However, the primary aim of our research was to evaluate consumer preferences for sneakers made with bio-based materials, focusing on sustainability-related attributes. The choice to omit branding and aesthetic factors was driven by the need to isolate the effect of these sustainability dimensions. Nonetheless, we acknowledge that such factors are relevant and should be integrated in future research to provide a more comprehensive understanding of consumer preferences.

CRediT authorship contribution statement

Fabio Cevenini: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Alessia Chelli:** Writing – review & editing, Writing – original draft, Methodology. **Sandra Notaro:** Writing – review & editing, Supervision, Conceptualization.

Declaration of competing interest

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

Data availability

Data will be made available on request.

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