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## Ecological products in online stores – consumer behavior in the light of TPB

Natalia Kozik<sup>a\*</sup>, Bartłomiej Kabaja<sup>a</sup>, Erica Varese<sup>b</sup>

<sup>a</sup>Krakow University of Economics, Rakowicka 27, 31-510 Kraków, Poland

<sup>b</sup>University of Torino, Department of Management, Corso Unione Sovietica, 218 bis, 10134 Torino, Italy

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### Abstract

The development of the e-commerce industry creates a new shopping environment for consumers. This brings both opportunities and threats. One observed problem is the low visibility and recognition of ecological products in this sales channel. This issue is becoming increasingly important in the era of growing climate threats and global warming. The aim of this study was to examine the variables influencing the attitudes, intentions, and behaviors of consumers when purchasing ecological products in online stores.

A survey method was used among 250 young consumers from Poland to achieve the set assumptions. The analysis and research design were based on the Theory of Planned Behavior, with certain modifications to reach the goal better. The results obtained from statistical analysis showed that the most significant influence on the purchase intentions of ecological products online is attitude, subjective norms, and subjective control of compliance. Meanwhile, the strongest impact on consumers' attitudes is ecological labeling in online stores, and this relationship is statistically significant.

These results prove that ecological labeling of products offered in e-commerce is very important in the process of purchasing these products. The results of this study should draw greater attention from retailers and decision-makers to the presentation and labeling of ecological products in e-commerce. Undoubtedly, this area will be very important in promoting sustainable consumer behavior, especially with the growth of online sales.

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*Keywords:* ecological products; e-commerce; eco-labeling; consumer behavior; TPB.

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\* Corresponding author. Tel.: +48 12 293 5171

E-mail address: [natalia.kozik@uek.krakow.pl](mailto:natalia.kozik@uek.krakow.pl)

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## 1. Introduction

E-commerce is growing rapidly. The growth of interest in products offered online is strongly observable, especially in the last decade [1]. In addition, unpredictable and previously unobserved events such as the coronavirus pandemic and related restrictions have recently emerged, which have had a positive impact on accelerating the development and popularisation of online shopping [2]. Currently, indicators describing online trade are very high [3].

In 2022, the percentage of businesses receiving orders exclusively electronically via websites or applications ranged from 33.7% in Lithuania to 9.6% in Romania. Among the determinants of this phenomenon was the need for companies to emphasize their online presence and visibility. Consequently, companies increasingly use websites and applications for various purposes [3].

For many observers and investors, this market is very future-oriented. Defined and significant future trends include the development of chatbots, voice search, Q-commerce, or live commerce [4]. Undoubtedly, the development of e-commerce will continue, and it will significantly affect many aspects of our daily and economic life [5, 6]. One of these is environmental protection and sustainability [7] and meeting the challenges of a circular economy [8].

These topics are a frequent focus of research. Fuzesi et al. [9] investigated perceptions of online food purchases. Here, concerns were raised about transporting these products from far-flung parts of the world, which contributes to carbon emissions. Ahmad and Zhang [10], on the other hand, highlight that online purchases of sustainable products result in a greater willingness to remain loyal to a particular brand. Other manacles of online sales were addressed by Kabaja et al. [11] when conducting ecolabel recognition research. This work showed that the labels used to distinguish ecological products in shops are unrecognizable by consumers. An assessment of the problem regarding over-packaging of food ordered online was undertaken by Varese et al. [12]. This research showed that not all consumers are aware of this. Possible measures taken by retailers to reduce packaging materials may be perceived positively by consumers.

These, as well as other findings from the studies analyzed, confirm that most e-commerce shop users demand environmentally friendly products [13]. Therefore, this study aimed to investigate the variables influencing consumers' attitudes, intentions, and behaviors when purchasing eco-friendly products in online shops.

## 2. Consumer behavior in e-commerce

With the development of the e-commerce business, there has been an increased interest in research on the impact of variables on consumer attitudes, intentions, and behavior when purchasing ecological products online. One of the key concepts for conducting this research is the Theory of Planned Behaviour [14]. TPB is based on three key elements: attitudes toward behavior, subjective norms, and subjective sense of control. Thus, it represents three types of consumer beliefs: core, normative, and control [15]. Over time, the concept has become central to subsequent modifications and the construction of models of consumer behavior in the online marketplace. Various behavioral decision theories and intention models have begun to be developed in the literature to investigate and predict consumer behavior [16]. Some of the most important concepts in this area include The Technology Acceptance Model [17], the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh [18], finally, the well-known and extended version of it called UTAUT2 [19]. The models presented are important theoretical concepts for studying behavioral factors related to consumer behavior.

Among other things, the state of research to date has identified that, despite all efforts, online shopping involves more significant uncertainty for consumers and requires greater standardization and simplification of the purchasing process [20]. In addition, consumers identify negative environmental impacts resulting from irrational packaging of products bought online [21]. Reducing this negative impact can have significant benefits in gaining consumer favor in online shopping. The considerable problem of consumer experience with cyber security was highlighted by Khatoon [22], who identified this element as one of the more significant ones. It appears that negligence in this aspect is often a reason to abandon online shopping.

The results of Nougén's [23] work indicated that perceived pleasure strongly influenced the intention to buy online. This means that behavioral intention was strongly influenced by customers' experiences of past online purchases. Therefore, an essential factor for e-commerce business is bringing consumers more hedonic value. This element will contribute to the improvement of this business. Another element is efficient reverse logistics, related to handling e-commerce orders. Customers also stressed the importance of this aspect [23]. An interesting predictor of online product purchases is the ease of use of shop websites and applications [24]. Ease of use affects perceived usability and consumer attitudes. If a shop's website or app is easy to use, potential customers will be more likely to purchase online. Another critical issue that can contribute a lot to the study of behavior in e-commerce is research into the effects of a first-time experience on evaluating this sales channel [25]. According to ongoing research, the first experience strongly influences the willingness to use a particular technology. Another key factor in e-commerce is the implementation of user-driven innovations. These activities leverage user knowledge to enhance a product [26]. Despite being a lesser-known approach, its potential to understand user needs and improve processes for promoting organic products in e-commerce is significant.

An exciting aspect of consumer motivation in purchasing ecological products was highlighted by Noubar et al. [27]. Namely, social media and online advertising. As the research indicates, these factors positively influence consumers' purchase of ecological products. Attributing significant value to them increases purchase intention. Noubar et al. [27] also highlighted the need to highlight the benefits of purchasing ecological products, increasing their attractiveness in consumers' eyes.

The literature review conducted, and the research gaps identified allowed the following hypotheses to be proposed:

- H<sub>1</sub>: Health awareness positively impacts consumer attitudes towards ecological products.
- H<sub>2</sub>: Environmental knowledge positively impacts consumer attitudes towards ecological products.
- H<sub>3</sub>: Environmental labeling has a positive impact on attitudes towards ecological products.
- H<sub>4</sub>: Attitude positively impacts consumers' purchase intention towards ecological products.
- H<sub>5</sub>: Subjective norms positively impact consumers' purchase intention towards ecological products.
- H<sub>6</sub>: Subjective sense of control positively impacts consumers' purchase intentions towards ecological products.
- H<sub>7</sub>: Purchase intentions positively affect consumer purchase behavior towards ecological products.

The conceptual model of the study is visualized in Fig. 1.

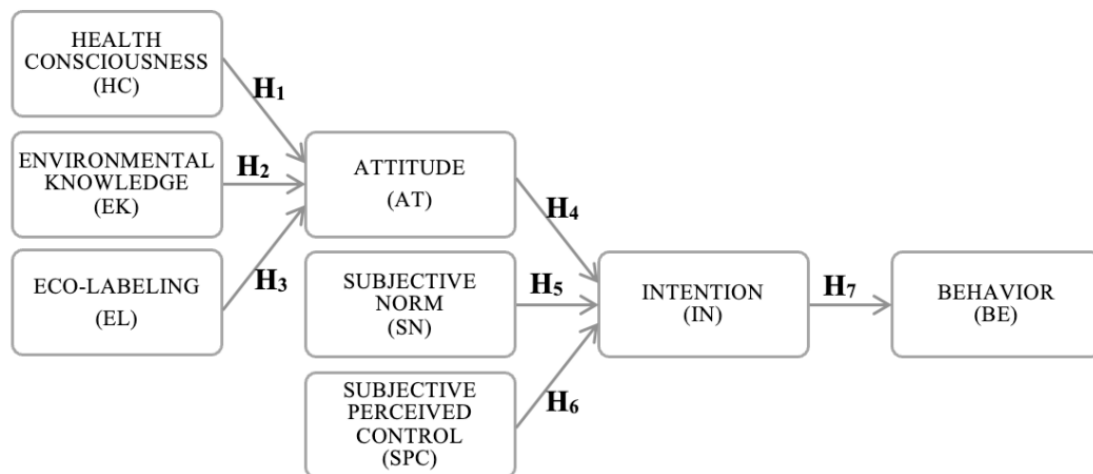


Fig. 1. The conceptual model of the study.

Today's fiercely competitive environment in the e-commerce market requires more detailed research to be undertaken to develop effective retail strategies. These must include guidelines for retailers on how to promote ecological products effectively.

### 3. Research methodology

The research tool was an electronic survey questionnaire, which was designed based on the assumptions of the Theory of Planned Behavior. In addition, as a result of the literature, it was assumed that three additional predictors likely to influence consumer attitudes would be included in the model, viz.:

- health consciousness [28, 29, 30],
- environmental knowledge [28, 30],
- eco-labeling [31, 32].

The survey was conducted in 2024 and was quantitative. Data collection was implemented through an online survey via Google Forms. Respondents were asked to indicate their agreement or disagreement (using a 5-point Likert scale, where a score of 1 meant ‘strongly disagree’ and a score of 5 meant ‘strongly agree’) with the statements concerning awareness of the constructs presented above. The questionnaire contained a total of 23 statements.

The questionnaire was completed by 250 Polish consumers aged 18 and over. The selection of respondents was intentional – the objects of the study were individual consumers who purchase organic products via the Internet. The study focused on young people because, as previous research has shown, pro-environmental issues are important to them when purchasing products [28], and the Internet is the most convenient way for them to buy various services and products [29]. In addition, understanding the perspective of young consumers is important, as they will be the main creators of consumption trends in the future.

Out of the total participants, 126 were female (50.4%), 122 were male (48.8%) and 2 were identified as another gender (0.08%). The majority of the sample was between 18 and 21 years old (62.4%). Most respondents lived in a city with more than 500,000 inhabitants (35.6%) or in a rural area (34.4%). The characteristics of the respondents are presented in Table 1.

Table 1. Sample demographics.

Characteristic		Frequency	Percentage
Sex	female	126	50.4
	male	122	48.8
	other	2	0.08
Age	18-21	156	62.4
	22-25	79	31.6
	26-29	2	0.08
	≥30	13	5.2
Place of residence	village	86	34.4
	town (up to 100,000 inhabitants)	44	17.6
	city (between 100,000 and 500,000 inhabitants)	31	12.4
	city (more than 500,000 inhabitants)	89	35.6

### 4. Results

Partial least squares structural equation modeling (PLS-SEM) was used to analyze the data, as this method has already been used and established in similar studies and is suitable for exploratory studies with high model complexity. The calculations were performed in SmartPLS 4.

In the first step, the reliability and relevance of the model was assessed. To assess the internal consistency of each construct used in the study, Cronbach's alpha coefficient ( $\rho_a$ ) was calculated. As indicated by the results obtained, this coefficient reached a value above 0.8 for each construct tested, indicating acceptable consistency. Also, the composite reliability values ( $\rho_c$ ) reached above 0.7, which, according to the proposed interpretation, suggests that the tool used met the reliability criterion. Furthermore, the convergent validity of the model was assessed. For this purpose, the average variance extracted (AVE) was calculated, and values above 0.5 were

reached. This is also in line with the accepted guidelines indicating that the constructs used in the model were correctly measured. The results are presented in Table 2.

Table 2. Construct reliability and validity.

Construct	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
AT	0.872	0.893	0.921	0.795
BE	0.901	0.902	0.953	0.910
EL	0.880	0.881	0.927	0.808
EK	0.805	0.821	0.885	0.721
HC	0.782	0.841	0.871	0.693
IN	0.931	0.933	0.956	0.879
SN	0.951	0.953	0.969	0.911
SPC	0.918	0.921	0.948	0.860

The discriminant validity indices of the model, i.e., the Fornell-Larcker index and the heterotrait-monotrait ratio (HTMT), were then determined. As indicated by the Fornell-Larcker index results obtained, the square roots of the AVEs for all constructs were higher than their highest correlation with any of the other constructs [33]. Therefore, according to the proposed interpretation, the model should be considered to have achieved discriminant validity based on the Fornell-Larcker criteria. The results are presented in Table 3.

Table 3. Discriminant validity – Fornell-Larcker criterion.

Construct	AT	BE	EL	EK	HC	IN	SN	SPC
AT	0.892							
BE	0.512	0.954						
EL	0.417	0.438	0.899					
EK	0.343	0.308	0.563	0.849				
HC	0.318	0.289	0.559	0.570	0.833			
IN	0.592	0.707	0.352	0.304	0.220	0.937		
SN	0.220	0.275	0.295	0.206	0.220	0.268	0.955	
SPC	0.515	0.341	0.345	0.411	0.287	0.407	0.163	0.927

For the second discriminant validity index tested, HTMT, all values obtained did not exceed 0.85, indicating that the model achieved discriminant validity and that all constructs tested in the model are different from each other [34]. The results are presented in Table 4.

Table 4. Discriminant validity – heterotrait-monotrait ratio (HTMT).

Construct	AT	BE	EL	EK	HC	IN	SN	SPC
AT								
BE	0.567							
EL	0.468	0.493						
EK	0.411	0.357	0.668					
HC	0.370	0.344	0.662	0.699				
IN	0.642	0.771	0.389	0.347	0.244			
SN	0.231	0.298	0.322	0.237	0.244	0.284		
SPC	0.581	0.375	0.383	0.478	0.327	0.439	0.174	

As the model had satisfactory reliability and relevance, the next step was to estimate the actual structural model. To assess the significance of the relationships in the TPB model, the bootstrap resampling/bootstrapping technique was used, i.e., estimating the distribution of estimation errors using repeated sampling with return from a sample. This method was applied for 5000 replicates and a 95% confidence interval.

The results showed a significantly positive relationship among 5 of the 7 relationships. The analysis concluded that eco-labeling ( $\beta=0.301$ ,  $p=0.000$ ) influences consumers' attitudes toward buying ecological products. No such influence was found for environmental knowledge ( $\beta=0.131$ ,  $p=0.055$ ) and health awareness ( $\beta=0.075$ ,  $p=0.296$ ). In addition, attitude ( $\beta=0.494$ ,  $p=0.000$ ), subjective norms ( $\beta=0.138$ ,  $p=0.027$ ), subjective perception control ( $\beta=0.130$ ,  $p=0.037$ ) were proven to influence purchase intentions towards ecological products and, in turn, intention ( $\beta=0.707$ ,  $p=0.000$ ) influenced consumer purchase behavior. Based on the above, it can be concluded that hypotheses H<sub>3</sub>, H<sub>4</sub>, H<sub>5</sub>, H<sub>6</sub>, H<sub>7</sub> were positively verified. In contrast, hypotheses H<sub>1</sub> and H<sub>2</sub> were rejected. The results obtained are presented in Table 5.

Table 5. Path coefficients.

Hypothesis	Relationships	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics ( O/STDEV)	P values	Decision
H <sub>1</sub>	HC→AT	0.075	0.081	0.072	1.045	0.296	Not supported
H <sub>2</sub>	EK→AT	0.131	0.126	0.068	1.919	0.055	Not supported
H <sub>3</sub>	EL→AT	0.301	0.297	0.060	5.004	0.000	Supported
H <sub>4</sub>	AT→IN	0.494	0.498	0.065	7.636	0.000	Supported
H <sub>5</sub>	SN→IN	0.138	0.138	0.062	2.215	0.027	Supported
H <sub>6</sub>	SPC→IN	0.130	0.129	0.062	2.084	0.037	Supported
H <sub>7</sub>	IN→BE	0.707	0.707	0.034	20.858	0.000	Supported

A graphical presentation from SmartPLS analytical software developed from the results obtained is presented in Figure 2. The yellow boxes are the statements assigned to the construct. Most of the constructs studied were assessed with 3 statements. The exception was the behavior construct, which was assessed with 2 statements. The values on the arrows are path coefficients ( $\beta$ ; original sample – presented in Table 5), while the values in the blue circles are Cronbach's alpha coefficient ( $\rho_a$  – presented in Table 2).

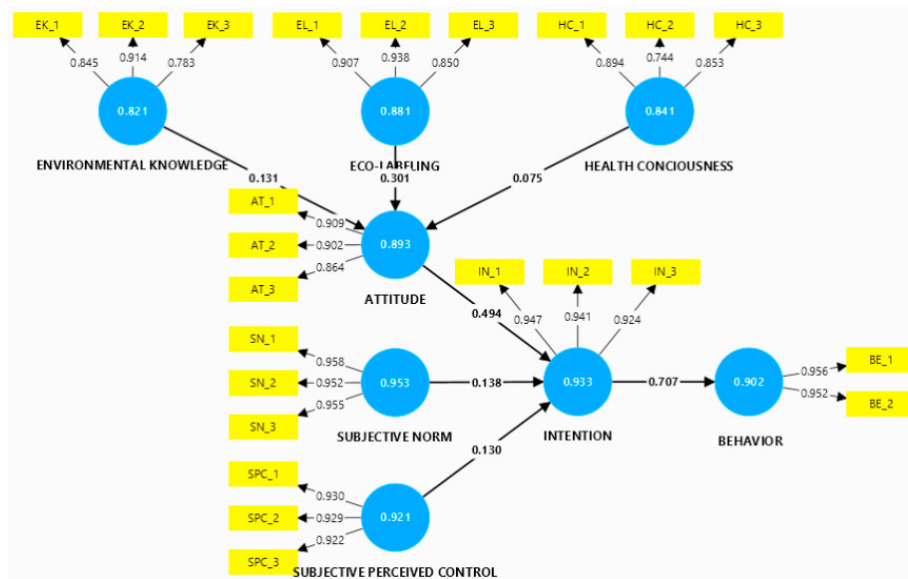


Fig. 2. PLS-SEM algorithm results – graphical output (path coefficients & outer loadings).

## 5. Conclusion

The study aimed to identify the variables influencing consumer behavior in purchasing ecological products online. Undoubtedly, this is a critical and socially necessary topic. But, at the same time, it is also tricky due to the development of the e-commerce market and consumers' shopping habits that are only just emerging. The main difference between this study and previous ones is that the scope of the studied determinants of online shopping behavior has been extended to include aspects such as health awareness, environmental knowledge, and ecolabeling. Thus, these elements have enriched the body of work of the theory of planned behavior (TPB) and can be used to better align the market offer of ecological products in the theoretical and commercial spheres.

One of the most significant findings is that the ecolabeling of products in online shops influences consumer attitudes and thus contributes to environmentally friendly purchases. Interestingly, this influence is substantial compared to environmental knowledge and health awareness determinants. The results obtained also confirm that attitude is still a significant factor in predicting e-commerce behavior for green products. The data obtained correspond with the results of other researchers Song and Jo [34] and Wang et al. [35]. The low impact of environmental knowledge and health consciousness on organic purchasing is explained by the behavior in which people without expertise in the described ranges are willing and inclined to purchase organic products. The high rate of attitude toward purchasing organic products was similar to values presented in other works of this kind, such as German Ruiz-Herrera et al. [36], and Peña-García et al. [37]. This regularity may be necessary in understanding and designing consumer information messages in online shops. The study's results already provide further evidence of the need for retailers and decision-makers to pay more attention to the problem of appropriate information messages in this particular communication channel of e-commerce. Indeed, a better presentation of ecological products online will contribute to more robust pro-environmental consumer behavior and more sustainable consumption. The study's limitations include a small and unrepresentative study group and its local nature. For future research into the customer behavior of online shops, it is suggested that the method be further extended to, for example, user-driven innovation [26] or multivariate correspondence analysis [38].

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