


Article

Study on Consumers' Purchase Intentions for Carbon-Labeled Products

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Abstract: The carbon-labeling system is able to quantify the level of greenhouse gas emissions of goods throughout their life cycle, including production, delivery, and consumption. With the proposal of carbon peak and carbon neutrality goals, the carbon-labeling system has an inevitable impact on production by companies and the purchase behavior of consumers. This paper constructs a theoretical model of the influencing mechanism on consumer willingness to purchase carbon-labeled products by utilizing the theory of consumption values. Through a survey and analysis of a sample of 347 Chinese university students, a regression analysis is applied to explore their willingness to consume carbon-labeled products and the corresponding influencing factors. The results show that (1) despite relatively low public awareness of the carbon-labeling system, the willingness to purchase carbon-labeled products is strong; (2) functional value, emotional value, and epistemic value can positively influence customer willingness to purchase carbon-labelled products; and (3) there is a significant difference in the willingness to purchase carbon-labelled products in terms of age and no significant difference in terms of gender, income, occupation, and education level. Based on the findings, some recommendations are made to help companies adopt appropriate strategies to trigger consumers' purchase intentions and gain a market advantage in carbon-labeling scenarios.

Keywords: theory of consumption values; carbon-labeled products; purchase intention



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1. Introduction

In recent years, the change in global climate has become increasingly severe and is the greatest non-traditional security challenge to human society. According to a report by the National Oceanic and Atmospheric Administration in January 2020, the average global temperature broke the record and the Antarctic temperature exceeded 20 degrees Celsius for the first time. Global warming poses a serious threat to the living environment and health of humans [1]. In 2021, China's carbon dioxide emissions reached 11.9 billion tons, accounting for 33% of the global emissions [2]. As the world's largest carbon-emitting country, China is actively reducing carbon emissions with enormous stress. On 22 September 2020, President Xi Jinping announced in the General Debate of the 75th Session of the General Assembly that China will strive to reach the CO₂ emission peak by 2030 and work towards achieving carbon neutrality by 2060 [3]. In March 2021, the Report on the Work of the Government again pointed out the need to optimize industrial structures and promote the green transformation of production and lifestyle. This vision of achieving the carbon peak and carbon neutrality goals has fully demonstrated China's determination and confidence in dealing with the global climate challenge and has put forward higher requirements for its transformation into a low-carbon society [4]. As an important tool to promote green consumption, the carbon-labeling system has received global attention [5,6]. It exhibits the greenhouse gas emissions of a product in its life cycle through a label and provides a basis for consumers to judge the sustainability of the product, thus helping customers to choose low-carbon and environmentally friendly products [7]. The first carbon-labeling project was implemented by Carbon Trust (U.K.) in 2006. Since then, some other developed

countries, such as the United States, France, Switzerland, Japan, and Canada, have adopted similar policies to reveal information regarding the environmental impact of the product or service [8]. The project aimed to promote consumer awareness of climate change and therefore guide their purchasing behaviors. China initiated the “carbon footprint labeling” project in 2018, which is relatively late compared to developed countries. In fact, the carbon-labeling system gradually began to receive public attention and came into the view of enterprises only since China proposed its carbon peak and carbon neutrality goals [9,10]. Although this concept has been repeatedly mentioned by the government, to the best of our knowledge, the research on public awareness of the carbon-labeling system in China is still missing.

The adoption of carbon labels can effectively and directly inform consumers about the environmental impact of products [11]. On one hand, consumers can acknowledge the carbon emissions information of products, eliminating the information gap between enterprises and consumers. This builds a bridge between the government, enterprises, and consumers to become involved in the construction of a low-carbon economy. On the other hand, the carbon-labeling system can improve consumers’ awareness of the potential impact of their consumption on climate change, therefore leading to low-carbon consumption. In this way, consumers can also be included in energy-saving and emission-reducing systems [12,13].

Many scholars have conducted multiple studies on consumers’ preferences, purchase willingness, and the corresponding influencing factors for carbon-labeled products. The carbon-labeling system provides the public with a right to know more about green issues and improves their awareness of the potential impact of their consumption behavior on climate change. Some studies, through an online survey in eight countries, showed that more than 80% of consumers are in favor of adopting carbon-labeling policies as a beneficial tool for mitigating climate change. It has also been shown that consumers are willing to pay a 20% premium for carbon-labeled products [14]. In terms of individual factors, demographic characteristics such as age, income, gender, and education also have significant effects on consumers’ willingness to purchase and pay [7,15]. Shuai et al. [16] and Zhao et al. [17], utilizing questionnaires and system dynamics simulations, found that people with higher educations and higher incomes have a stronger willingness to purchase carbon-labeled products. Zhao et al. [7] and Peschel et al. [18] found similar results: the higher the level of education of customers, the more likely they are to develop environmentally friendly behaviors and therefore have stronger preferences for low-carbon products. Mostafa [19] used parametric and nonparametric econometric models to predict Egyptian consumers’ willingness to purchase carbon-labeled products and found that the age of consumers showed a negative correlation with their purchase willingness. Li et al. [20] took the purchase willingness for low-carbon products of residents in a city of Jiangsu Province as a research subject and found that, with an increase in consumer age, the willingness to pay first increases and then decreases. However, Chen et al. [21] found that older consumers have a higher willingness to pay. Brunner et al. [14] found that gender does not affect consumers’ purchase-willingness through a consumption experiment. However, the study of Liang et al. [22] showed that female consumers are more likely to purchase carbon-labeled products when compared to males.

Furthermore, attention paid by customers to product property, including label information, brand, word of mouth, price, and packaging, also influences their intentions to purchase and pay. Vanclay et al. [23] showed that the public tends to be curious about novel goods, making the information on the carbon label an influencing factor on consumer purchasing behavior. Babakhani et al. [24] taking food service as an example, utilizing behavioral observation and eye-tracking techniques, confirmed that the carbon-labeling system can effectively stimulate the consumption of green foods. However, a study by Hartikainen et al. [11] found that the carbon-labeling system is not a key influencing factor in eliciting purchase intention and that the information on the label will only be considered by consumers when the price and quality of the product are satisfied. Rööös et al. [25] also

found similar results, in which the study showed that, although consumers are concerned about the carbon footprint information of organic food to some extent, the origin and price are more strongly considered. In addition, it was reported that consumers' perceptions of low-carbon products, environmental responsibility, social norms, and educational campaigns also have a positive effect on their consumption attitudes and behavior toward low-carbon products [20,21].

In summary, the research on carbon-labeling systems is at a relatively early stage, either in countries that have implemented a carbon-labeling system or that have not yet implemented a carbon-labeling system. Although abundant research exists in this area, the following shortcomings still exist. First, the degree of public attention to carbon-labeling systems is less-addressed by Chinese domestic research, making the social popularity of this concept unknown. Second, the theoretical models of consumer behavior have not been constructed yet, and this topic has not been scientifically investigated from the theoretical mechanism point of view. Third, the selected objects of existing research are too general, and research on segment groups has not been conducted. Based on these factors, this paper begins, from the perspective of the theory of consumption values, to study the influencing mechanism of the carbon-labeling system on the purchase intentions of consumers. In addition, college students, who are keenly aware of the environmental challenge, receptive to novel popularity, and inclined to participate in sustainable consumption, constitute a large group of future low-carbon consumers and contribute to the spread of environmentally friendly consumption concepts. Based on this, this study focuses on Chinese college students and analyzes their purchase intention and the underlying theoretical mechanism towards carbon-labeled products using questionnaire data.

This study can effectively fill the gap of concern regarding the purchase intention of carbon-labeled products in China, construct a scientific model from the theory of consumption value, and select a group of college students to enable a more focused research object. The influencing mechanism of carbon-labeling systems investigated in this work can provide useful references for developing and promoting carbon-labeled products furtherly and effectively. At last, this work proposes a few reasonable suggestions for China's carbon-labeling system to promote the development of China's low-carbon economy.

2. Theoretical Model and Research Hypothesis

2.1. Theoretical Model

The theory of consumption values was first proposed by Sheth et al. [26] and contains five consumer values that influence consumer choosing behavior, including functional value, social value, emotional value, epistemic value, and conditional value. Since then, the theory of consumption values has been widely applied in sociology, psychology, and consumer behavior. Long and Schiffman [27] applied the theory to segment consumers based on their values and relationships with service providers and to understand consumption motivation and behavior. Sweeney and Soutar [28] used functional value, social value, and emotional value to develop a perceived value scale to evaluate customer perceptions of the value of durable goods at the brand level. Additionally, in recent years, scholars have continuously improved the traditional theory of consumption values to study its impact on green consumption behaviors. For example, Khan and Mohsin [29] used consumption values to study the effect of the values of customers on the environmental concern exhibited by Pakistan consumers when purchasing green products. The results of the study showed that functional value (price), social value, and environmental value have a positive impact on green product consumer choice behavior, while conditional value and epistemic value have a negative effect. In addition, the subjects of this paper are college students, who are subordinate to the consumer group, so we believe that the consumption value theory is also applicable to the subjects of this paper [30]. Comprehensively integrating domestic and international literature on the eco-labeling system, combined with the theory of consumption values, and taking functional value, social value, emotional value, conditional value, and epistemic value as variables, this study establishes a theoretical model of the

factors affecting consumers' intention to purchase carbon-labeled products, as is shown in Figure 1.

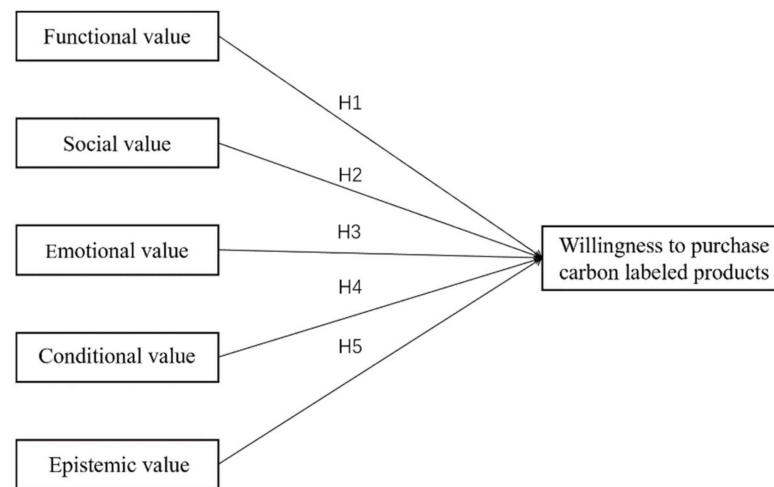


Figure 1. Theoretical model of willingness to purchase carbon-labeled products.

2.1.1. Functional Value and Willingness to Purchase Green Products

Sheth et al. [26] defined functional value as “The perceived utility acquired from an alternative’s capacity for functional, utilitarian, or physical performance”. This is measured by consumers’ perceptions of products’ performances, such as durability, price, and reliability, etc. Bei and Simpson [31] argued that, due to short- or long-term cost reductions, the utility that consumers derive from a product has functional value, and they divided the functional value into two dimensions: price and quality. It is commonly believed that rational consumers will pursue the maximum benefit at the lowest cost. Therefore, consumers usually evaluate the value of a product based on the comparison between its price and quality to facilitate purchase decisions in real life. Laroche et al. [32] showed that price sensitivity is a key factor influencing consumers’ purchase decisions on green products. The published empirical studies have shown that consumers’ purchase behavior is influenced by their functional value, and functional value is the main driving force for consumers when making purchase decisions on environmental-friendly products. Thus, the following hypothesis is proposed.

Hypothesis 1 (H1). *Functional value (price and quality) has a positive effect on consumers’ willingness to purchase carbon-labeled products.*

2.1.2. Social Value and Willingness to Purchase Carbon-Labeled Products

Social value measures the perceived utility acquired from an alternative’s association with one or more specific social groups. Sheth et al. [26] believed that social value, as an important dimension of consumer-perceived value, has a significant impact on consumer purchase behavior. Mi et al. [33] found that social reference group is an important factor influencing consumers’ low-carbon consumption behavior. Family, friends, and other social groups can have a positive influence on individuals’ low-carbon consumption behavior. Typically, consumers want to construct a positive image of themselves by purchasing a certain product. Therefore, the higher level of perceived social value by customers, the more likely they are to engage in certain consumption behaviors. In empirical studies on the influence of social values on consumer purchase behavior, Biswas and Roy [34] confirmed that social value has a significant positive effect on Indian consumers’ purchase behavior with respect to green products. Based on the discussion above, the following hypothesis is proposed.

Hypothesis 2 (H2). *Social values have a significant positive effect on consumers' willingness to purchase carbon-labeled products.*

2.1.3. Emotional Value and Willingness to Purchase Green Products

Emotional value is the perceived utility acquired from an alternative's capacity to arouse feelings or affective states [26]. Goods and services are often associated with emotional response [28]. The importance of emotional value can be seen in the comments of MacKay [35], who pointed out that the attractiveness of a product or service is a mixture of rational and emotional factors and that emotions play a role in every purchase decision. Bei and Simpson [31] found that the majority (89.1%) of respondents usually consider themselves to be protecting the environment when purchasing recycled products. Therefore, this study proposes the following hypothesis.

Hypothesis 3 (H3). *Emotional value has a significant positive effect on consumers' willingness to purchase carbon-labeled products.*

2.1.4. Conditional Value and Willingness to Purchase Green Products

The conditional value indicates the perceived utility acquired by an alternative as the result of the specific situation or set of circumstances facing the choice maker [19]. A study on consumer purchase intention found that changes in situational variables may affect consumers' consumption of environmentally friendly products [29,36,37]. When the situational variables of consumers, such as personal situations, change, their purchase behavior may be affected. Studies on soft drinks, snacks, beer, and breath fresheners have shown that product sales and purchases are often a response to specific situations. Considering that the current climate is worsening, people are becoming more environmentally conscious. Thus, the following hypothesis is proposed [38].

Hypothesis 4 (H4). *Conditional value has a significant positive effect on consumers' willingness to purchase carbon-labeled products.*

2.1.5. Epistemic Value and Willingness to Purchase Green Products

Epistemic value was originally defined as the perceived utility acquired from an alternative's capacity to arouse curiosity, provide novelty, and/or satisfy a desire for knowledge [26,39]. Consumers tend to satisfy the desire for knowledge about product property and novelty, which favorably influences consumer behavior in purchasing carbon-labeled products [40]. As a new and environmentally responsible product, carbon-labeled products can satisfy consumers' curiosity and desire for novelty. Products lacking information about carbon emission usually lead to an attitudinal-behavioral gap between consumers' concerns about environmental issues and their actual purchase behavior [41], which can be filled by the carbon-labeling system. Therefore, this study proposes the following hypothesis.

Hypothesis 5 (H5). *Epistemic value has a significant positive effect on consumers' willingness to purchase carbon-labeled products.*

3. Methodology

3.1. Questionnaire Design and Methodological Description

This study used a questionnaire to collect data. First, based on the model investigated by this paper, the preliminary questionnaire targeting the research questions of this work was designed referring to historical research [28,34,42,43]. The structure and content of the preliminary questionnaire were then adjusted through pre-research, leading to the formal questionnaire. The formal questionnaire consisted of four parts with twenty-five questions in total. The first part included the description of the questionnaire, which mainly informed the respondents of the research goal and introduced the carbon-labeling

system to them. The second part was a survey on the demographic characteristics of the respondents, such as gender, age, occupation, and education level, etc. The third part was a few scales on the purchase intention, functional value, social value, epistemic value, and emotional value of carbon-labeled products. These five-point Likert scales take values of one to five to indicate responses of “completely disagree”, “disagree”, “unsure”, “agree”, and “completely agree”, respectively. The fourth part was an open question posed with the intention of understanding respondents’ opinions on carbon-labeled products.

Sheth et al. [26] proposed a theory of consumption values that influence consumers’ purchase intentions. Sweeney and Soutar [28] developed a measurement scale of consumption values based on this. In the study of consumer behavior toward green products, Lin and Huang [43], Biswas and Roy [34], and Suki et al. [42] adapted this scale based on the characteristics of green products and formed a more sophisticated scale of consumption values targeted at green products. In this paper, we designed a questionnaire applicable to carbon-labeled products with a high reliability and content validity, referring to the aforementioned research. According to the aim of the study, the questionnaire was distributed online as well as offline to Chinese university students. A total of 400 questionnaires were distributed randomly for one month. Among them, 347 questionnaires were returned, with a valid return rate of 86.75%.

This study focuses on the analysis of the questionnaire data through regression equations. First, a descriptive analysis of the sample was conducted; second, SPSS software was used to analyze the reliability and validity of the questionnaire to test the reliability of the questionnaire; then, a correlation analysis was conducted again to determine the preliminary relationship between consumer value theory and consumer intention, after which the consumer purchase intention was selected as the dependent variable, and the effect of consumer-perceived value was examined using regression methods to test the research hypothesis. Finally, in order to test the effects and differences of consumer demographic characteristics on consumers’ willingness to purchase carbon-labeled products, a one-way ANOVA and an independent sample *t*-test were used to explore this issue.

3.2. Analysis of Study Results

3.2.1. Descriptive Statistics

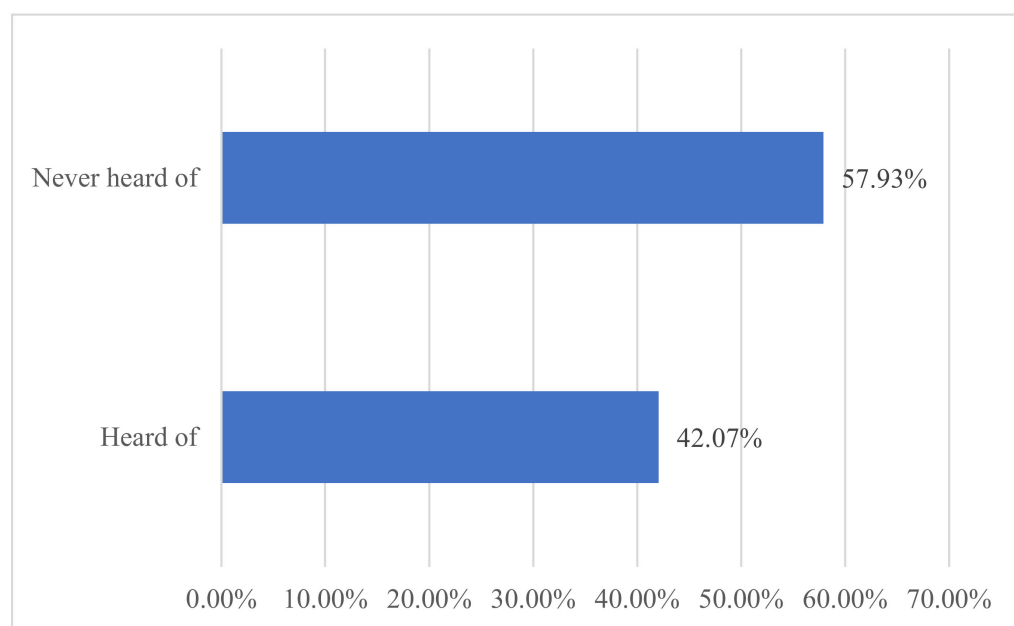
The demographic information of respondents is shown in Table 1. From the table, we can tell that the majority of the consumers in this study were female, and the age of the respondents mainly fell in the range of 19–29 years old, which is relatively young. This group of people is one of the mainstream consumer groups in the market, with a relatively strong purchasing capability and willingness for novel products. These characteristics make them high-potential consumers of green and low-carbon products. Furthermore, the respondents generally had a high level of educational background and advanced cognitive capability, which makes it easy for them to absorb new knowledge and develop environmental awareness. Additionally, respondents were mostly students with low to medium disposable income level, which is consistent with their identity. In summary, the respondents in this survey were young, highly educated, and in line with the targeted research group for this study.

3.2.2. Analysis of the Awareness and Purchase Intention of Carbon-Labeled Products

Figure 2 summarizes the respondents’ awareness levels of carbon-labeled products. Among 347 respondents, only 42.07% of them declared that they had heard of carbon-labeled products, indicating a low level of awareness of the carbon-labeling system in society at present, which requires further propaganda in the future.

Table 1. Demographic information of respondents.

Classification Indicators		Number	Percentage	Standard Deviation	Mean
Gender	Male	103	29.68%	0.46	1.7
	Female	244	70.32%		
Age	Under 18	14	4.03%	0.57	2.15
	19–29	281	80.98%		
	30–40	41	11.82%		
	41–50	7	2.02%		
	Over 50	4	1.15%		
Occupation	Student	232	66.86%	1.45	1.9
	Freelancer	20	5.76%		
	Teachers, doctors, researchers, etc.	34	9.8%		
	Government officer	22	6.34%		
	Corporate employees	36	10.37%		
	Retired	3	0.86%		
Education level	Bachelor's degree	279	80.4%	0.40	2.2
	Master's degree and above	68	19.6%		
Monthly income	<5000	223	64.27%	0.86	1.56
	5000~10,000	65	18.73%		
	10,000~20,000	46	13.26%		
	>20,000	13	3.75%		

**Figure 2.** Respondents' awareness of carbon-labeled products.

Questions 7–9 in the questionnaire asked about purchase intention regarding carbon-labeled products. From Table 2, it can be seen that the respondents had strong purchase intentions regarding carbon-labeled products. Of the respondents, 73.2% agreed or strongly agreed with the statement, “I will consider purchasing carbon-labeled products”. Up to 66.28% of the respondents agreed with the statement, “I will recommend others to buy carbon-labeled products” and 67.72% of the respondents agreed with the statement that they were “I’m willing to collect and learn about carbon-labeled products”. Only very few (<2%) respondents expressed resistance to carbon-labeled products.

Table 2. Purchase intentions regarding carbon-labeled products.

Questions	Options	Number	Percentage
I will consider purchasing carbon-labeled products	Strongly agree	94	27.09%
	Agree	160	46.11%
	Neutral	80	23.05%
	Disagree	7	2.02%
	Strongly disagree	6	1.73%
I will recommend others to buy carbon-labeled products	Strongly agree	93	26.8%
	Agree	137	39.48%
	Neutral	107	30.84%
	Disagree	7	2.02%
	Strongly disagree	3	0.86%
I’m willing to collect and learn about carbon-labeled products	Strongly agree	83	23.92%
	Agree	152	43.8%
	Neutral	91	26.22%
	Disagree	14	4.03%
	Strongly disagree	7	2.02%

3.2.3. Reliability and Validity Test

To ensure the rationality of the acquired data, the reliability and validity of the questionnaire scale were analyzed as the first step [44]. The scale used in this study was developed based on previous studies that passed expert review and therefore possessed high content validity. In this paper, the reliability of the questionnaire scale was examined using the Reliability Analysis Function in the SPSS26 software. From Table 3, the results showed that the overall Cronbach’s α value of the questionnaire was 0.924, in which the α values of the purchase intention and function value exceeded 0.8, and the α values of social value, emotional value, conditional value, and epistemic value exceeded 0.7, indicating a high internal consistency of the scale. An exploratory factor analysis was also conducted using the same software to examine the construct validity of the questionnaire scale. As is shown in Table 4, the results of the exploratory factor analysis showed that the KMO coefficient of the overall sample was 0.938, greater than the standard value of 0.7. The probability of significance of Bartlett’s sphericity test was infinitely close to 0, which rejects the original hypothesis and validates the questionnaire.

Table 3. Reliability test.

Latent Variables	Cronbach’s α Coefficient	Scale Overall Cronbach’s α Coefficient
Purchase intention	0.82	0.925
Function value	0.873	
Social value	0.773	
Emotional value	0.762	
Conditional value	0.78	
Epistemic value	0.734	

Table 4. Validity test.

KMO	0.938
Approximate chi-square	2914.695
degree of freedom	105
Significance	0.000

3.2.4. Correlation Analysis

Correlation analysis is a statistical method for studying the correlation between random variables. It can analyze the dependence between the studied phenomena and explore the direction and degree of correlation. Before the overall model validation, the correlations between the purchase intention of carbon-labelled products and the functional, social, emotional, conditional, and epistemic values were first analyzed to explore the dependency relationship between these variables. In this paper, we used correlation analysis to explore the structure of the relationship between consumer values and consumers' purchase intentions toward low-carbon products. A preliminary test of the correlation between these two variables is conducted, which also provides a reference for the subsequent analysis. The results of the analysis are shown in Table 5.

Table 5. Correlation coefficients.

	Purchase Intention	Function Value	Social Value	Emotional Value	Condition Value	Epistemic Value
Purchase intention	1					
Function value	0.677 **	1				
Social value	0.594 **	0.703 **	1			
Emotional value	0.651 **	0.597 **	0.652 **	1		
Condition value	0.596 **	0.656 **	0.654 **	0.679 **	1	
Epistemic value	0.414 **	0.374 **	0.398 **	0.334 **	0.386 **	1

** At the 0.01 level (two-tailed), the correlation is significant.

From this table, it can be seen that the functional value, social value, emotional value, conditional value, and epistemic value are all significantly correlated with consumers' purchase intentions toward carbon-labeled products at the 0.01 significance level. Furthermore, the positive correlation coefficient indicates a significant positive correlation. The preliminary relationship between consumers' perceived values and purchase intentions toward carbon-labeled products is revealed through the correlation analysis.

3.2.5. Regression Analysis

In this paper, consumer purchase intention was selected as the dependent variable to examine the influence of consumer-perceived values on it and to verify the research hypothesis. A multiple linear regression model was chosen to analyze the relationship between the dependent and independent variables.

The regression analysis in Table 6 shows that the functional value has a significant effect on consumers' purchase intentions toward carbon-labeled products ($p < 0.01$), which validates Hypothesis H1. It indicates that the quality and price of carbon-labeled products are important determinants of consumer choice, which is consistent with the findings of previous studies on consumer behavior. As rational people, consumers are very sensitive to price changes, whereas the carbon-labeling system, as an emerging system, is bound to increase cost due to displaying carbon emissions on the package. However, manufacturers should prevent transferring this part of the cost to the product price, causing unnecessary product premiums and thus hindering consumers from purchasing. In addition, the quality of the product is also an important factor for consumers to purchase. However, carbon-labeled products only add the element of a "carbon label" to the original product, which does not affect the quality of the product.

Table 6. Regression coefficients.

Independent Variable	Regression Coefficient	Standard Deviation	Standard Regression Coefficient	<i>p</i> -Value	VIF
(Constant)	0.068	0.106		0.521	
Function value	0.361	0.052	0.375	0.000	2.327
Social value	0.024	0.05	0.026	0.641	2.518
Emotional value	0.308	0.05	0.323	0.000	2.188
Conditional value	0.058	0.051	0.063	0.254	2.402
Epistemic value	0.147	0.044	0.131	0.001	1.238

Dependent variable: customer purchase intention.

From the table, we can also observe that there is no significant effect of social value on customers' purchase intentions toward carbon-labeled products ($p > 0.1$), which invalidates hypothesis H2. Such a result points out that the purchase of carbon-labeled products owing to social media or interpersonal communication is not common at present, and consumers are not triggered by the people around them. The producers and the government also do not strengthen the promotion and publicity of carbon-labeled products. Moreover, consumers do not seem to be under social pressure to protect the environment or believe that it is the responsibility of the government or companies.

Emotional value has a significant effect on customers' purchase intentions toward carbon-labeled products ($p < 0.01$), which validates hypothesis H3. Considering that the investigated objects in this study all received or were receiving higher education and therefore possessed a strong sense of environmental responsibility, it is reasonable to conclude that they were willing to obtain emotional value through their support and purchase of carbon-labeled products. Consumers can feel pleasure and satisfaction by purchasing carbon-labeled products that satisfy their sense of responsibility for ecological protection because this consumption behavior contributes to the achievement of peak carbon and carbon neutrality goals.

No significant effect of conditional value on customers' purchase intentions toward carbon-labeled products ($p > 0.1$) can be observed, which invalidates hypothesis H4. It implies that consumers lack a crisis awareness of the environmental problems faced by human beings at present and are not aware of the necessity of protecting the environment through their consumption behaviors. In a word, there is no environmentally specific constraint for customers when making a purchase decision.

Epistemic value has a significant effect on customers' purchase intentions toward carbon-labeled products ($p < 0.01$), which validates hypothesis H5. The group investigated mainly consisted of college students, who are willing to experience and understand novel stuff and have a strong desire to learn. Consequently, they can smoothly accept and develop a desire for carbon-labeled products, and such epistemic values can facilitate their purchase and use of carbon-labeled products.

3.2.6. Analysis of Variance and Means

In this session, a one-way ANOVA and an independent sample *t*-test were utilized to verify the influence of consumers' demographic characteristics (including gender, age, occupation, education level, and income) on their willingness to purchase carbon-labeled products. Based on the analytical tests, we can observe that there are significant differences in customers' willingness to purchase carbon-labeled products in terms of age and no significant differences in terms of gender, income, occupation, or education. In the following section we will focus on analyzing the effect of age differences on the purchase intention toward carbon-labeled products for policy and market decisions.

Given that age is divided into multiple groups, a one-way ANOVA was used to analyze the differences in the purchase intention for carbon-labeled products among consumers of different age groups. The results are shown in Table 7.

Table 7. One-way ANOVA of age and purchase intention.

		Sum of Square	Degree of Freedom	Quadratic Mean	F	Significance
Purchase intention	Inter-group	6.763	4	1.691	3.100	0.016
	Inner group	186.553	342	0.545		
	Total	193.317	346			

From the data in the table, a significant difference in the purchase intentions of consumers of different ages can be seen by the mean value (<0.05) of the significance test. The mean value of the scores on the purchase intentions of consumers at different ages is further analyzed and shown in Table 8.

Table 8. Comparison of the mean values of willingness at different ages.

Age	Mean	Number	Standard Deviation
Under 18 years old	2.333	14	0.827
19–29 years old	2.069	281	0.730
30–40 years old	2.138	41	0.764
41–50 years old	3.000	7	0.544
Over 50 years old	2.167	4	1.036
Total	2.108	347	0.747

This result is consistent with the findings of previous research, in which Johnson et al. [45] confirmed a significant effect of age on consumption intention. Specifically, the purchase intention of carbon-labeled products was the strongest in the age group of 41–50 years old, with a mean value of 3. Customers in this group are generally the main decision-makers of household consumption, are exposed to a broader range of information, and have more sophisticated knowledge and understanding of themselves, rendering them the ability and willingness to purchase and use low-carbon products. This conclusion is similar to the findings of Kumari [46]. In addition, consumers in this age group also pay more attention to healthcare and therefore have a higher requirement for the environment. A high purchase intention for consumers under 18 years old could be a result of curiosity about novel products. This is consistent with previous research, which indicated that the younger the age, the higher the pursuit will be of new things [47,48]. Despite the fact that customers in the age range of both 19–29 and 50+ are also main consumers, customers between 19 and 29 years of age have a relatively low purchase capacity, customers over the age of 50 are relatively reluctant to buy novel goods.

4. Discussion

This study contributes to the literature in several ways. First, this study contributes to the literature on carbon-labeled products. Several studies have investigated the effects of carbon labeling on consumer behavior [11,49]. However, few studies have examined the purchase intentions of specific consumer groups [8]. To the best of our knowledge, no study has directly investigated the purchase intention of carbon-labeled products among a group of Chinese university students except for Zhao et al. [7], who studied the purchase intention toward low-carbon products among consumers in Chengdu, China. Consistent with the findings of Zhao et al. [7], our findings suggest that it is important to consider different consumption contexts when studying consumers' carbon-labeling consumption behavior. Thus, our study contributes to the willingness to purchase carbon-labeled products by gaining a better understanding of Chinese college students' consumer purchase behavior toward carbon-labeled products. Some studies have also pointed out that different consumer groups have different consumption intentions, and this study helps address the gap in existing research by targeting university students [9].

Second, this study contributes to the consumption value theory [26]. The consumption value theory has been one of the most widely used models for examining environmental behavior [27]. Several studies have also applied consumption value theory to various green consumptions, such as the study on purchasing green and organic products [29]. In this study, we combined consumption value theory with functional value, social value, emotional value, conditional value, and cognitive value as variables that affect consumer's willingness to purchase carbon-labeled products, and accordingly constructed a theoretical model of the influence mechanism that affects consumer willingness to purchase carbon-labeled products. Our results confirm the appropriate application of the consumption-value theoretical model in our context and show that functional value, affective value, and cognitive value have significant effects on college student consumers' willingness to purchase carbon labels. This study also theoretically extends the application of consumption value theory.

In addition, demographic characteristics such as gender, age, occupation, education level, and income differed from the results of previous studies, with previous literature suggesting that women were more willing to consume green products and that education level and income were positively associated with a willingness to consume green products [50–52]. The results of this paper show that there were significant differences in consumers' willingness to purchase carbon-labeled products in terms of age, but no significant differences in terms of gender, income, occupation type, or education level [53]. The study in this paper controlled the experimental group as college students, so the experimental group is characterized by higher education and a stronger awareness of environmental protection needs. For this highly knowledgeable group, age difference is an important factor in their difference in willingness to purchase carbon label products. Therefore, in the design and sale of carbon labels, it is important to consider a differentiated strategy for target groups of different age stages.

5. Conclusions and Recommendations

This paper builds a model of consumers' willingness to purchase carbon-labeled products based on the theoretical framework of consumption value. Based on 347 valid questionnaires given to Chinese university students, the model is validated using regression techniques. The following conclusions are drawn: (1) the public has a low awareness of the carbon-labeling system, but has a strong purchase intention; (2) functional value, emotional value, and epistemic value can positively influence consumers' willingness to purchase carbon-labeled products, whereas social value and conditional value do not have a significant influence on customers' purchase intentions toward carbon-labeled products; and (3) customers' purchase intentions toward carbon-labeled products are significantly different in terms of age and have no significant differences in terms of gender, income, occupation, and education level.

From a theoretical perspective, this study is the first to incorporate the consumer value theory to develop a model that explains the motivational drivers of consumers' willingness to purchase carbon-labelled products by integrating various key aspects, providing useful insights into the environment and providing a reference for subsequent research, as well as making some contribution to the body of knowledge. From a practical perspective, this study provides guidance for managers to develop more effective marketing strategies for carbon-labeled products and helps to better understand consumer behavior toward carbon-labeled products, which not only helps companies to gain unexpected benefits, but also benefits the environment and the sustainable development of society as a whole. Based on the findings of this paper, the following recommendations can be proposed. (1) Owing to the current low awareness of the carbon-labeling system among customers, the government should improve the publicity and promotion of carbon-labeling system and innovate the form and media that will popularize the knowledge of the carbon-labeling system. Additionally, the government can advocate for a low-carbon lifestyle, which lays a foundation for the implementation and promotion of the carbon-labeling

system. Creating more and increasingly novel scenarios of low-carbon consumption that are participatory, accessible, and perceptible can also cultivate awareness of low-carbon consumption and stimulate a preference for carbon-labeled products among customers. (2) The functional value of carbon-labeled products perceived by consumers is a key factor affecting consumers' purchase intentions. From the perspective of a company, the functional value can be enhanced by developed production technology, reduced production costs, or improved quality, which can serve as important guidance for the promotion of its carbon-labeled products. Additionally, green promotion activities related to the carbon-labeling system may effectively increase customers' purchase intentions. The government can establish an incentive system for carbon-labeling certification and provide certain subsidies, tax benefits, and administrative supports to enterprises or platforms that voluntarily participate in the carbon-labeling certification system. (3) Taking the emotional value as the entry point, companies can highlight the green and environmental characteristics of carbon-labeled goods through marketing strategies using advertising and promotion which can trigger customers' purchase behavior. Another possible attempt would be building a platform in collaboration with a widely used and highly active green social media, such as "Ant Forest," that enables people to conveniently share the carbon emission of their consumption by using the QR code on the carbon label. Such a platform can promote an energy-saving and emission-reducing lifestyle and can also develop the public's low-carbon awareness and sense of honor in purchasing carbon-labeled products. (4) Improving the perceived value of carbon labeling can be organically popularized with other topics such as climate change, air pollution, energy conservation, and environmental protection. These familiar topics can promote consumers' understanding, recognition, and acceptance of carbon labeling, and facilitate the change of consumer behavior to environmentally friendly behavior. Some practical strategies can also be applied to increase public awareness of carbon-labeling-system participation. For example, innovating the design of the carbon label logo by integrating traditional cultural elements or collecting ideas from the public can help stimulate public interest, participation, and access to the carbon-labeling system. In addition, selecting targeted information to be displayed on carbon labels can satisfy consumers' curiosity and desire for knowledge and can also facilitate the promotion of the carbon-labeling system. (5) Given that consumers' willingness to purchase carbon-labeled products varies by age, it is important to consider different strategies for different age target groups when designing and marketing carbon-labeled products.

6. Limitations and Future Research

This paper investigates the purchase intention of Chinese college student consumer groups towards carbon-labeled products. However, there are still many unknown factors that influence actual purchase behavior, from the generation of purchase intentions to the implementation of the actual purchase behavior. For future research, the key factors and their influencing mechanisms in the process from intention generation to actual purchase behavior can be further investigated. Since consumers' lifestyles and values tend to influence their choices, judgments, and actions, and the research subjects chosen for this study had relatively high education and income levels, the scientific validity of the findings of this study may be affected to some extent. In the future, we can further enrich and supplement the number, type, and level of the sample to test the propositional hypotheses. Willingness to pay for carbon-labeled products is a dynamic process in which not only information affects willingness to pay, but the consumer's interaction with that information is also a factor. This interaction may change the perceived value of the product. Therefore, future research may examine the impact of carbon-labeling information on consumers' willingness to pay for carbon-labeled products. Finally, in this study, we used consumption value theory and regression models with closed-ended questions for the questionnaire. However, open-ended questions may provide clearer bounds on consumers' willingness to pay. Therefore, future studies may use multiple experimental approaches to obtain more valid results.

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