

# Research on Acceptance Willingness and Sustainable Development of Green Cosmetics under the Background of "Double Carbon"

## --Based on Structural Equation Modeling

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### Abstract

Structural Equation Model (SEM) was used to analyze the influencing factors of consumers' willingness to accept green cosmetics under the background of "dual carbon", and AMOS21.0 software was used to perform structural equation analysis on the obtained 930 valid sample data and hypothetical models. Model fit test. The research results show that consumers' subjective norms of green beauty have a significant impact on consumers' willingness to accept, and finally provide suggestions for the low-carbon transformation and sustainable development of my country's green beauty from the four dimensions of government, enterprises, products, and individuals.

### Keywords

Green beauty; consumers' willingness to accept; sustainable development; structural equation modeling.

## 1. Research background

"Green", "environmental protection" and "sustainable" have been considered as the inevitable direction of global economic transformation since they were proposed in the 1980s. With the continuous deterioration of the ecological environment and the increasingly tight natural resources, green sustainability has become the top priority of today's international society. With the implementation of the national goal of "carbon neutrality" and the accelerated implementation of a series of new regulations on cosmetics, "sustainable development" has become a compulsory course for the development of future beauty brands.

In recent years, with the rapid development of the cosmetics market, its pressure on the environment is also increasing. In order to attract the attention of consumers and earn more profits, enterprises often have excessive packaging and flashy phenomena. According to the survey, the cosmetics industry produces 2.7 billion discarded plastic empty bottles every year, and the annual discharge of packaging waste in my country is in the weight of It has accounted for one-third of urban solid waste in the world, and even reached one-half in volume. The discharge is increasing at an astonishing rate of 10% per year, and the chemical wastewater and waste cosmetics produced in the production of cosmetics pollute the air, soil and water sources.

Due to the lack of effective recycling channels, more than 70% of plastic products are directly discarded or incinerated and landfilled [1, 2], which has a bad environmental impact. Therefore, green design is an unavoidable development trend in the packaging industry [3]. Under the background of "carbon peaking and carbon neutrality", it is very necessary to reduce excessive packaging and adopt reduction design measures to achieve green packaging [4].

In terms of national policies and guidelines, accelerate green and low-carbon transformation and realize green recovery and development. General Secretary Xi Jinping emphasized in the

report of the 20th National Congress of the Communist Party of China that "high-quality development is the primary task of building a socialist modern country in an all-round way" and "promoting green and low-carbon economic and social development is the key link to achieve high-quality development." Actively and steadily promote carbon peaking and carbon neutrality, China will strive to achieve carbon peaking by 2030 and carbon neutrality by 2060. Fully implement sustainable development. General Secretary Xi Jinping pointed out that sustainable development is "an inevitable outcome of the development of social productivity and scientific and technological progress. China upholds the development concept of innovation, coordination, green, openness and sharing to promote the high-quality development of China's economy.

In terms of cosmetics regulations, Article 9 of the "Regulations on the Supervision and Administration of Cosmetics" adopted by the executive meeting of the State Council in 2020 clearly stated that it encourages and supports the use of modern science and technology, combined with my country's traditional advantageous projects and characteristic plant color resources, to research and develop cosmetics; The "Regulations on the Administration of Filing Data" has made relevant requirements for alternative methods of "animal testing". From May 1 of the same year, China exempted "imported general cosmetics" from relevant laws and regulations such as animal testing; Commodity packaging needs to strengthen supervision and law enforcement, resolutely curb the phenomenon of excessive packaging of commodities, and provide strong support for promoting the green transformation of production and lifestyle and strengthening the construction of ecological civilization.

With people's pursuit of environmental protection and healthy life, as well as policy support, sustainable development has become an inevitable trend of the entire beauty industry, and "green environmental protection" will also become the main theme in the cosmetics packaging market [5]. At present, in my country, green and sustainable development is being accelerated through a series of policies, regulations and measures. Internationally, the basic principles of green design have also been introduced, such as: 4R1D principles [6] and 9R principles [7]. As one of the fastest growing markets in recent years, it provides fertile soil for the low-carbon transformation and sustainable development of the cosmetics industry. For example, L'Oreal, LanzaTech, and Tota jointly launched sustainable packaging [8] initiatives; NandK.Jha integrated green design and manufacturing within the framework of sustainable development, and proposed analysis techniques to minimize costs, reduce material waste, and reduce energy consumption in the manufacturing process [9,10]

At present, scholars at home and abroad lack systematic and in-depth research on the mechanism of influence on the willingness to accept green cosmetics. Based on this, combined with the theory of planned behavior, this paper constructs an evaluation index system of green beauty acceptance willingness from the four dimensions of consumers' acceptance attitude, perception norms, subjective norms, and personal trust, establishes its structural model, and explores the influence of green beauty on sustainable development. development factors, and put forward countermeasures and suggestions to promote the low-carbon transformation of green beauty and its sustainable development.

## 2. Theoretical Basis and Research Hypothesis

### 2.1. Theoretical basis

Relevant scholars pointed out that the concept of green cosmetics should be defined from several aspects such as raw materials, production, and packaging. That is: one is to use pure natural plant raw materials, and try not to use pigments, preservatives and essences that are irritating to the skin, so as to reduce the harm of chemical substances to the human body; Environmentally harmless production and experimental technology put pollution prevention

and control first; the third is to use biodegradable and recyclable packaging materials to avoid environmental pollution. With the development of global economy and technology, the sustainable development of green cosmetics will become an inevitable trend.

The theory of planned behavior is the most widely used in the study of the factors influencing intention to use. The Theory of Planned Behavior (TPB) incorporates behavioral attitudes, subjective norms, and perceived behavioral control [11]. The theory of planned behavior proposed by Ajzen et al. [12] believes that behavior is not only explained and predicted by behavioral attitudes, but also depends on subjective norms and perceived behavioral control. the behavior of.

Structural equation modeling (SEM) is a measurement technique that can express, measure and analyze the complex causal relationship between sample data with corresponding model equations.

The structural equation model is divided into two important parts, namely the measurement model and the structural model; the measurement model is used to analyze the relationship between the apparent variable and the latent variable; and the structural model uses the path analysis method to establish the relationship between the latent variables. And analyze the relationship between latent variables [13].

## 2.2. Research Hypothesis

In this paper, the following assumptions are made on the relationship between the various influencing factors of the comprehensive evaluation model of consumers' willingness to accept.

Hypothesis 1 (H1): Consumers' subjective norms positively affect their willingness to accept green cosmetics. The behavior of consumers using green cosmetics will be affected by the surrounding environment. Consumers purchase green beauty products as a rational and constrained behavior of consumers [14]. If they feel that the people around them have a greater influence on their behavior, they will have a more positive attitude towards the purchase of green beauty products. .

Hypothesis 2 (H2): Consumers' perceived norms of green cosmetics have a positive impact on consumers' personal trust. Through the research, it is found that there are two major factors that will affect people's green consumption behavior, they are environmental awareness and consumption value. Environmental awareness refers to people's level of awareness and understanding of the environment and environmental protection; when consumers buy commodities, their cognition and emotion will be influenced by their value. Classifying these two factors as perception norms, consumers' perception norms will promote their trust in green beauty products.

Hypothesis 3 (H3): Consumers' acceptance of green cosmetics positively affects their subjective norms. The more positive consumers' acceptance of green beauty products, the greater their influence from those around them.

Hypothesis 4 (H4): Consumers' personal trust positively affects consumers' willingness to accept green cosmetics. Consumers have more trust in product quality and product promotion when purchasing products, and they also have more trust in various government policies. Trust in the green beauty product market will promote consumers to accept green beauty makeup.

Hypothesis 5 (H5): Consumers' perceived norms positively affect consumers' willingness to accept green cosmetics. The higher the environmental awareness of consumers, the higher the perceived usefulness of green cosmetics, and the higher the willingness to accept green cosmetics.

Hypothesis 6 (H6): Consumers' perceived norms positively affect consumers' subjective norms. The higher the environmental protection awareness of consumers, the higher the perceived

usefulness of green cosmetics, and the more they can be influenced by the people around them to buy green beauty products.

### 3. Questionnaire design and data sources

#### 3.1. Questionnaire design

In addition to surveying basic information such as gender, age, education level, income level, occupation and use of beauty makeup of the respondents, the questionnaire mainly asks about the respondents' acceptance of green beauty makeup, personal trust, perceived norms, subjective Norms and willingness to accept.

In order to ensure the scientific nature of the scale, the scales designed for the questionnaire all adopt the Likert (likert) five-order scale, and set "strongly disagree", "disagree", "neutral", "neutral" and "neutral" for each scale item There are five options of "relatively agree" and "strongly agree", and the satisfaction is marked as 5, 4, 3, 2, 1 from high to low.

Since variables that cannot be directly observed are defined as latent variables, they need to be measured by observed variables. The selection of latent variables this time is based on theory, and according to the exploratory analysis results of the data, accepting attitudes, perceived norms, subjective norms, personal trust, and willingness to accept are selected for analysis. The settings of the corresponding observation variables and the corresponding problems are shown in Table 1.

Table 1 Settings of questionnaire items (variables)

latent variable	observed variable	Question content
acceptance attitude	acceptance attitude1	I understand and agree that green beauty can be green and environmentally friendly
	acceptance attitude2	I think green beauty is the future development direction of the beauty industry
	acceptance attitude3	I think it is necessary to promote green beauty
perceptual norms	perceptual norms1	I think green beauty makeup is cost-effective
	perceptual norms2	I think green beauty is friendly to the environment
	perceptual norms3	I think green beauty makeup is healthier for the human body
	perceptual norms4	I think green beauty is more in line with the concept of green consumption
subjective norm	subjective norm1	The people around me have a higher degree of influence on my acceptance of green beauty makeup
	subjective norm2	I will take the initiative to respond to the call and accept green beauty makeup
	subjective norm3	I accept the promotion of green beauty by media, community and environmental protection organizations
personal trust	personal trust 1	I think the chemical ingredients in green beauty products are all natural
	personal trust 2	I think the government's policy on the green beauty industry is in place

	personal trust 3	I think all the hype about green beauty in the market is believable
Willingness to accept	Willingness to accept 1	I am willing to accept and consume from the media community
	Willingness to accept 2	I would like to take the time to learn about green beauty
	Willingness to accept 3	I would like to recommend green beauty to my friends

### 3.2. Data sources

Taking Anhui Province as the main survey object, and aiming at the sustainable development of green cosmetics, using methods such as field research, personnel interviews, and online distribution of questionnaires, 1024 questionnaires were actually distributed to residents of Anhui Province with the PPS four-stage sampling method, and the recovery was effective. There are 930 questionnaires, with an effective rate of 90.82%, and the data have passed the reliability, validity and randomness tests, and the questionnaire results are true and reliable.

## 4. Model fitting and structural analysis

### 4.1. Reliability and validity test

Based on 930 valid questionnaires, using SPSS20.0 software to calculate consumer acceptance willingness and its 4 latent variables and 16 observation variables, the total Cronbach's coefficient is 0.966, which is between 0.9 and 1, indicating that the internal consistency of the questionnaire is very good, respectively. Cronbach's coefficients were calculated for the observed variables corresponding to the four latent variables, and the Cronbach's coefficients of the grouping reliability and validity test indicators were 0.920, 0.831, 0.889, and 0.967, respectively. All exceeded the high reliability value of 0.7 [15], indicating that the content reliability of each measurement index reached acceptable standards and above.

The convergent validity (AVE) and combination reliability (CR) of each dimension of the scale were further tested. The inspection process calculates the standardized factor loading of each measurement item on the corresponding dimension through the established CFA model. Then, the convergent validity value and combined reliability value of each dimension are calculated by the calculation formula of AVE and CR. According to the standard, the minimum requirement of AVE value is 0.5, and the minimum requirement of CR value is 0.7, in order to show that it has good convergent validity and combination reliability.

According to the analysis results, it can be seen that in the validity test of the Green Beauty Acceptance Scale, the AVE values of each dimension have reached above 0.5, and the CR values have reached above 0.7. It can be comprehensively shown that each dimension has a good The convergent validity and combination reliability of the survey data have good validity.

Table 2. The relationship between each observed variable and the corresponding latent variable

path relationship			Estimate	AVE	CR
acceptance attitude1	<---	acceptance attitude	0.834	0.581	0.805
acceptance attitude2	<---	acceptance attitude	0.715		
acceptance attitude3	<---	acceptance attitude	0.759		

perceptual norms1	<---	perceptual norms	0.816	0.655	0.883
perceptual norms2	<---	perceptual norms	0.794		
perceptual norms3	<---	perceptual norms	0.821		
perceptual norms4	<---	perceptual norms	0.808		
subjective norm1	<---	subjective norm	0.818	0.673	0.86
subjective norm2	<---	subjective norm	0.802		
subjective norm3	<---	subjective norm	0.847		
personal trust 1	<---	personal trust	0.84	0.671	0.859
personal trust 2	<---	personal trust	0.794		
personal trust 3	<---	personal trust	0.821		
Willingness to accept 1	<---	Willingness to accept	0.84	0.702	0.875
Willingness to accept 2	<---	Willingness to accept	0.831		
Willingness to accept 3	<---	Willingness to accept	0.845		

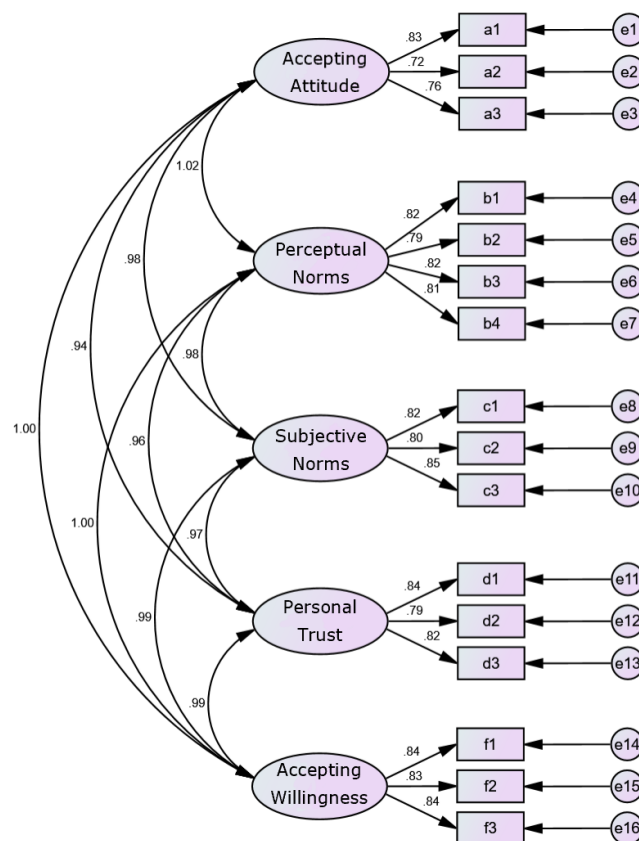


Figure 1 Standardization path of the structural equation of residents' willingness to accept green cosmetics

#### 4.2. Fitting results and hypothesis testing

The surveyed 930 valid questionnaire data and the theoretical model of the influence mechanism of consumers' willingness to accept green cosmetics were fitted with a structural equation model. The standardization path of the structural model is shown in Figure 1, and the



main fitness test indicators are shown in Table 3. . According to the model fitting test results in this table, it can be seen that CMIN/DF (chi-square degree of freedom ratio) = 1.291, in the excellent range of 1~3, RMSEA (root mean square error) = 0.025, in the excellent range of <0.05 within range. In addition, the test results of IFI, TLI and CFI all reached an excellent level above 0.9. Therefore, based on the analysis results of this time, it can be shown that the SEM model of acceptance intention of green cosmetics has a good degree of fit.

Table 3 The main fitness test indicators of the model

index	Guideline	results of testing
CMIN/DF	1-3 is excellent, 3-5 is good	1.291
RMSEA	<0.05 is excellent, <0.08 is good	0.025
IFI	>0.9 is excellent, >0.8 is good	0.996
TLI	>0.9 is excellent, >0.8 is good	0.994
CFI	>0.9 is excellent, >0.8 is good	0.996

According to the symbol rules of the path diagram of the structural equation model, draw the path diagram of the causal relationship of the model, and stipulate that one of the coefficients in the measurement index corresponding to each latent variable in the model is 1, which is equivalent to specifying the measurement unit of the latent variable and the corresponding measurement index. The unit is the same; the measurement error coefficient of the measurable variables of exogenous latent variables and endogenous latent variables is stipulated as 1, and the causal relationship path diagram is set up.

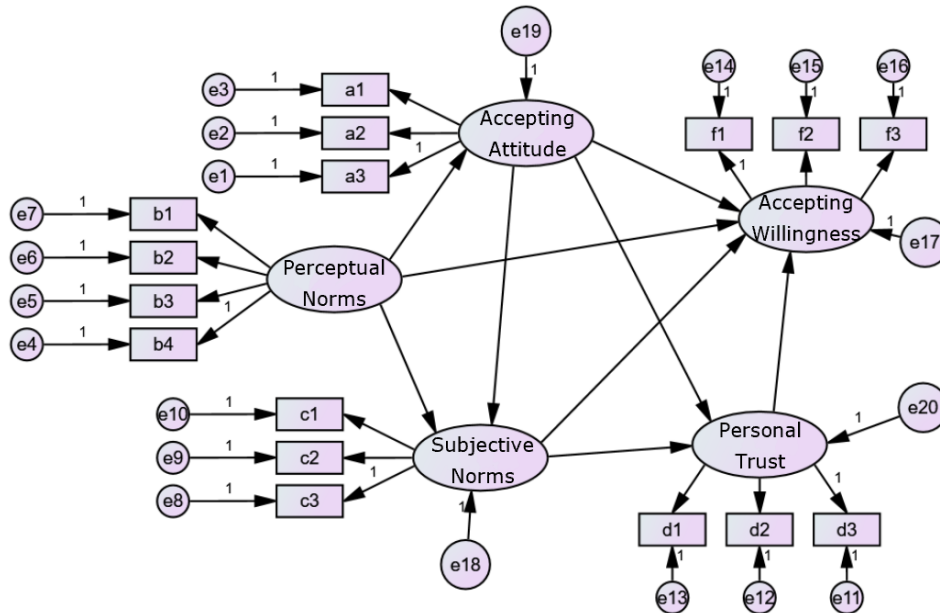


Figure 2 Structural equation path diagram of residents' willingness to accept green cosmetics

Table 4 Fitting results and hypothesis testing of theoretical models

path relationship			Estimate	S.E.	C.R.	P	in conclusion
Willingness to accept	<---	subjective norm	0.632	0.052	support	<0.01	support
Willingness to accept	<---	acceptance attitude	0.612	0.284	support	<0.01	support
subjective norm	<---	acceptance attitude	0.361	0.52	support	<0.01	support
Willingness to accept	<---	personal trust	0.413	0.264	support	<0.01	support
Willingness to accept	<---	perceptual norms	0.398	0.459	support	<0.01	support
subjective norm	<---	perceptual norms	0.607	0.491	not support	>0.01	not support
personal trust	<---	acceptance attitude	0.16	0.309	support	<0.01	support
personal trust	<---	perceptual norms	0.128	0.434	not support	>0.01	not support
Willingness to accept	<---	subjective norm	0.022	0.405	not support	<0.01	not support

It can be seen from the test results that the assumptions H1-H5 are established, but the assumption H6 is not established.

The coefficient among latent variables indicates the extent to which a change in one variable causes changes in other variables. As shown in the figure above, the regression coefficient between residents' subjective norms and willingness to accept green cosmetics in the conclusion drawn from the survey samples is 0.632, indicating that an increase in residents' subjective norms by 1 percentage point will directly increase residents' willingness to accept. The degree increased by 0.632 percentage points. It can be seen that subjective norms have the greatest impact on willingness to accept.

Similarly, for the latent variable personal trust, the regression coefficient between the degree of public trust in the society and the degree of acceptance is 0.413, which means that an increase of residents' trust in the government by 1 percentage point will directly affect the degree of acceptance, and the degree of residents' willingness to accept will increase by 0.413 percent. Residents' perceived norms have little effect on the degree of willingness to accept, and a regression coefficient of 0.160 means that an increase of 1 percentage point in acceptance attitude will increase residents' willingness to accept by 0.16 percentage points.

The regression coefficients of the latent variable acceptance attitude on subjective norms are 0.561, we can get from the positive and negative of the data, the impact of acceptance attitude on subjective norms is positive. The regression coefficients of the latent variable personal trust and perceived norms on the willingness to accept are 0.413 and 0.398, respectively. From the positive and negative nature of the data, we can get that the influence of the attitude towards acceptance and perceived norms on the willingness to accept is significant.



## 5. Countermeasures and Suggestions

The research results show that consumers' subjective norms of green cosmetics have the greatest impact on acceptance intentions, and their acceptance attitudes and perceived norms have a positive impact on consumers' acceptance intentions. Therefore, increasing the publicity of green beauty cosmetics, improving consumers' subjective norms and consumer acceptance attitudes will help to increase consumers' willingness to consume, thereby further promoting the sustainable development of green beauty makeup. The following is a review of green beauty makeup. Countermeasures and suggestions for low-carbon transformation and sustainable development.

### (1) Government

The government should formulate relevant laws and regulations to encourage and support the transformation of relevant beauty products companies to green beauty products. The products in the market meet the relevant requirements; government departments should strengthen law enforcement and crack down on counterfeit and shoddy beauty products according to law. Brands that focus on organic skin care must abide by strict regulations and be certified by organic standards of certification agencies. In terms of marketing value, it is safe, healthy, green, and environmentally friendly, and provides a unified, open, fair, just, and standardized market environment for the green beauty industry.

### (2) Enterprise

Popularize the correct concept of green beauty products to consumers, and promote green beauty to consumers in a variety of ways, such as green beauty blind box, famous IP joint name, popular celebrity endorsement, pattern live streaming, etc., to promote green beauty closely following the trend knowledge about cosmetic products, improve consumers' awareness of green cosmetic products, promote the purchasing power of green cosmetic products, stimulate and create consumers' demand for green cosmetic products, and then expand the green cosmetic market; at the same time, enterprises should increase investment in scientific research to realize the R & D and upgrade of green cosmetics product ingredients and packaging to achieve "green standards"; Unify standards, unite multiple companies to unify standards, establish industry standards, etc. to formulate unified specifications for product packaging, and can follow the S, M, and L sizes of clothing to formulate large, medium, small, cylindrical, and square sizes of beauty packaging bottles. Style, specify a clear size and shape for each outer bottle, so that consumers can only buy the inner core of the product they need when they make a second purchase, launch a recycling plan for empty bottles, and create a packaging recycling method, thereby reducing the use of packaging.

### (3) Product aspects

Technological innovation in the cosmetics industry has become one of the key factors driving the development of the industry. With the continuous development of artificial intelligence, big data, cloud computing and other technologies, cosmetics brands have begun to use technological means to improve the efficiency and quality of product development, production and sales. For example, analyze consumers' skin conditions and needs through artificial intelligence and big data technology, develop more accurate and suitable cosmetic products, and provide consumers with a real digital AR virtual makeup trial online shopping experience, thereby improving the sales of the platform or brand conversions and revenue. With the rapid development of extraction and synthesis processes, beauty products have more and more choices from ingredients to packaging. Today, customers and consumers in the care industry are paying more and more attention to the "non-toxic and harmless" product formula. Cosmetic brands pay attention to the sustainability and environmental protection of the production process, choose environmentally friendly materials, and implement circular economy measures to reduce their impact on the environment. Cosmetics stores should introduce

reusable product packaging + replaceable inner cores, so that consumers can always use the product outer packaging, and only need to buy supplementary products to replace when they are used up. Brands can set up special refilling areas in offline stores, Guide consumers to refill the product.

#### (4) Personal aspects

Consumers should actively respond to the government's call, earnestly study the relevant national "green and low-carbon" policies, practice "green awareness", live a green life, do not reject knowledge related to green beauty, and actively accept new things. In response to counterfeit and shoddy green beauty products, we must actively respond to government regulatory agencies, protect our own rights and interests, and prevent subsequent people from being harmed, so as to provide strength for the industry and society to create a fair, just, and standardized market environment. Consumers should actively give feedback on how they feel about using green beauty products, provide suggestions for the development of green beauty companies in my country, and urge companies to iteratively update products to meet the needs of more consumers.

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