

# Study on Emotion Sustainability Packaging Design Based on Carlo Model

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**Abstract:** In order to reduce the ecological pollution caused by packaging waste, improve the emotional packaging, prolong the life cycle of packaging. By combining the theory of emotional sustainability with the Carlow model, relevant data were collected through the methods of "user interview", "fuzzy comprehensive evaluation", "questionnaire survey" and so on. Based on the analysis of the Carlow model, design elements to improve packaging emotional sustainability were obtained, and the design optimization direction of emotional sustainability packaging based on user needs was established. It provides a feasible solution to effectively enhance consumers' emotional demand for packaging and extend the life cycle of packaging.

**Keywords:** Packaging design; Carlo model; Emotion Sustainability Theory; Sustainability

## 1. Preface

In the context of the significant increase in productivity, the design trend, which is dominated by human desires and economic interests, deviates from the ecological and social values, and the environmental pollution caused by excessive packaging, packaging waste, inferior packaging and commodity packaging waste is becoming increasingly serious. Irreversible damage to the natural system. According to the survey data, the annual production of packaging consumables in China is nearly 35 million tons, and the abandoned packaging waste is about 16 million tons, showing an increasing trend year by year, which undoubtedly has a huge pollution to the ecosystem.

One of the causes of packaging pollution is the lack of design. Due to the short life cycle of packaging, when the product is taken out, the packaging will become useless and cannot escape the fate of being discarded. We lack the emotional packaging of interactivity and multiple meanings to keep users engaged for long periods of time. Based on the above dilemma, this paper combines the theory of affective sustainability with the Carnot model to form a research framework based on evidence-based design. In order to extend the life cycle of packaging and improve packaging emotion, a quantifiable, strategic and systematic design solution mode is proposed.

## 2. Analysis of relevant academic research and current situation

### 2.1. Overview of the theory of affective sustainability

Emotion sustainable design is to extend the life cycle of products from the perspective of emotional factors by establishing a lasting emotional relationship between "users and products", to eliminate waste fundamentally and to achieve sustainable development. The concept was developed by Professor Jonathan Chapman, who argues that the current cause of endless waste is that users and products do not establish a pattern of continuous evolution and progress [1]. Therefore, based on the three design theories of sustainable design, emotional design and user-centered design, he proposed a design concept that is more compatible and effective in a broad sense. This design theory opens up a new world for sustainable design and also puts forward a theoretical framework for the research of emotional packaging.

### 2.2. Overview of research on Carlo theory and analytical model

Kano Model is a quantifiable demand analysis method [2], which was proposed by Professor Kano Kitano of Tokyo Institute of Technology to study how desire for different needs affects user satisfaction. The method classifies the attributes of the product, identifies which attributes can most affect the user's satisfaction with the product, and transforms the user satisfaction from unquantifiable to quantifiable,

strategic and systematic data model. According to the Carlo model, the five requirements, basic demand, expected demand, charm demand, reverse demand and indifference demand, are defined as the factors that affect user satisfaction (as shown in Figure1). Each requirement presents a different satisfaction curve. Charismatic needs can surprise users, but they will not be disappointed when they are lacking. Expectation demand is that when the increase and decrease of functions, the user satisfaction also presents a positive change; The basic requirement is that satisfaction drops sharply when the function is not met; Undifferentiated demand refers to the fact that there is no obvious response to user satisfaction when the function is satisfied or not satisfied. Reverse demand refers to the demand that should be avoided.

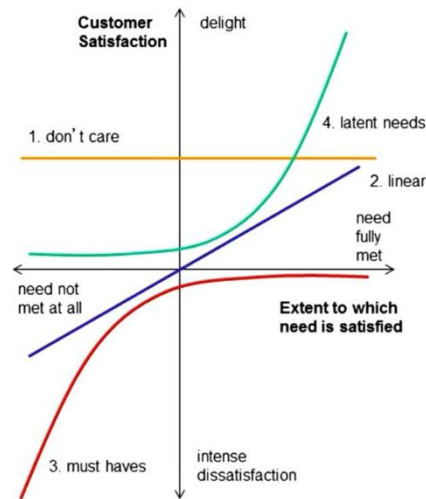


Figure.1 Kano model diagram

### 3. Research on the design of emotional sustainable packaging based on user needs

The research route of this paper can be divided into four stages. One is data collection. Based on the social value theory, the "fuzzy comprehensive evaluation" method is used in the form of interviews to combine packaging emotionalization with the user emotional interaction level proposed by Donald Norman to construct the user demand list of emotionally sustainable packaging. The second is the questionnaire survey. The method of Carlo model is used to design the questionnaire of user satisfaction. After the questionnaire is collected, the reliability and validity of the questionnaire are tested to ensure the maximization of the quality and effectiveness of information disclosure. Thirdly, multi-dimensional data analysis was conducted. Based on the Carlo model, the user demand attribute types of each element were evaluated. According to the Better -- Worse coefficient matrix, the important degree sequence table of the factors affecting the emotional sustainability of packaging was obtained. Fourthly, based on the analysis of user demand data, the optimization direction of emotional sustainable packaging design is summarized.

#### 3.1. User fuzzy demand confirmation based on interview and observation

Firstly, the on-site observation method was used to observe the consumers who went to the local supermarket for shopping during a period of one week (5 working days and 2 public holidays, from 8.00 am to 10:00 am and from 17:00 to 21:00 am). It focuses on the user's age, occupation, time period of shopping, behavioral characteristics of products measured through packaging, aesthetic preferences and other information, and the data is recorded in the form of live video and text. According to the summary results, 6 typical users (3 men and 3 women, aged 15-65 years) were invited to participate in the user interview, through which a list of users' vague needs was sorted out.

#### 3.2. Build a list of user needs for emotional sustainability packaging

Combining packaging emotionalization with the user emotional interaction level (instinctive layer, behavioral layer and reflective layer) proposed by Donald Norman [3]. Quantify the emotional elements generated by the interaction between packaging and users in the whole life cycle, find the breakthrough point of design, and form the user demand list of emotional sustainable packaging. In order to facilitate

the subsequent sorting and coding processing, the system is divided into three first-level indicators, the codes are L1, L2, L3, and 13 second-level indicators, the codes are Q1, Q2, Q3..... Q13 (shown in Table 1).

*Table 1 User demand list of emotional sustainable packaging*

The emotional stage of packaging	The user needs	coding	Emotional level
L1 First encounter stage	Attracted by the text design of the packaging	Q1	Instinct layer
	Be attracted by the shape design presented by the package	Q2	Instinct layer
	Attracted by the materials used in the packaging	Q3	Instinct layer
L2 purchase stage	The brand reputation of the products is very good and trustworthy	Q4	Behavior layer
	Basic commodity information, such as description and price, is clearly stated on the package	Q5	Behavior layer
	The design style of packaging is different from that of similar products	Q6	Behavior layer
	Packaging products designed by famous designers or award winners	Q7	Behavior layer
	Understand and meet the needs of users when packaging is opened	Q8	Behavior layer
	Conformity of product and package information commitments	Q9	Behavior layer
	Packing makes people feel interesting and comfortable	Q10	Behavior layer
L3 use stage	Product and packaging can be combined to use, in use to understand and meet the needs of users	Q11	Reflection layer
	The structure of the package is multi-functional and can be reused	Q12	Reflection layer
	The packaging design is meaningful and the expression technique is narrative	Q13	Reflection layer

### **3.3. Questionnaire design and reliability analysis based on the Carlo model**

According to the research method of the Carlo model, the questionnaire of user satisfaction was designed. The user needs are summarized as "Very dissatisfied, dissatisfied, average, satisfied, very satisfied" five attributes. When the question is asked, set five answer options from both the forward "if this function is implemented" and the reverse "if this function is not implemented" angles. This survey issued a total of 129 questionnaires, issued on June 5, 2020 solstice June 20, 2020, the main target is the urban population with a stable source of income. According to the results of the questionnaire, male respondents accounted for 47.29% of the total number of people, and female respondents accounted for 52.71% of the total number of people. The ratio that female respondents were slightly higher than male respondents was also consistent with the ratio obtained from field research. Most of the respondents are office workers with stable income, accounting for 55.04%, while there are also 20.16% students, 18.6% freelancers and 6.2% others. The age span is average and reasonable. 81.4% respondents all give the affirmative answer to whether the outer package plays a decisive role in the selection of goods. It also proves the user's demand for packaging. In order to verify the reliability of the questionnaire results, Cronbach reliability analysis was carried out on the questionnaire, and the result was 0.918 (any value above 0.8 could be included in the reliability range).

### **3.4. Evaluation of user requirement attributes based on Carlo model**

The results of the questionnaire were analyzed in multiple dimensions by the quality requirement type assessment table based on the Carlo model. Firstly, the ratio of users' answers on positive and negative questions in the survey questionnaire was counted, and the percentage of the highest value was calculated

by the formula  $N = \text{MAX}\{p(A, O, M, L, R)\}$ . Where N represents the final requirement attribute of a function, and p represents the percentage of each requirement attribute in the number of all attributes. The requirement type of this function can be determined by taking the maximum value.

There are 5 charm needs, accounting for 38%. Its attribute is that when it is not satisfied, the user's satisfaction will not decrease, but once it is satisfied, the user's satisfaction will significantly increase, forming an emotional curve value from "ordinary" to "very satisfied". Through the analysis, it can be concluded that the difference of packaging design style, the combined use of packaging and commodities, and the meaning of packaging design will greatly improve the emotional experience of users. Especially, when the basic needs have been met, the charm demand will bring unexpected surprises to users, which becomes the key to the emotional packaging.

There are four expected demands, accounting for about 21%. Its attribute is that when users are satisfied, they will be "very satisfied", but when their demands are not satisfied, users' satisfaction will also decrease rapidly, forming an emotional curve value from "very dissatisfied" to "very satisfied". Through the analysis, it can be concluded that the material of packaging should be comfortable and environmentally friendly, so as to avoid the cognitive deviation of users on packaging function and image caused by the difference of material. And in the product brand publicity, through the packaging of this catalyst design users multi-dimensional understanding of the brand, and the brand resonance. In terms of comfort, the opening force of the package should be adjusted within the range of human comfort to avoid "packaging anger". All these design optimization will greatly improve the satisfaction of users.

Two no difference demand, its properties are satisfied and not satisfied when the user does not have a significant response, through the analysis can be obtained, the user of text and images on the package design of emotional sensitivity is weak, also prove that users of packaging the establishment of the emotional, not only through a single visual sense, but also need multidimensional sense to cooperate. Underlying demand 2, its attribute is the user on the function will not have a clear response to be satisfied, but when is satisfaction speed down, form a "general" to "very dissatisfied" emotional curve, through the analysis can be obtained, clear product basic information on the package, commitment to product and packaging information uniformity, are all essential basic elements in packaging design.

### ***3.5. Analysis of user satisfaction coefficient based on Carlo model***

According to the classification of user demand attributes, the user satisfaction of improving or decreasing packaging emotion is quantitatively analyzed by using the Better -- Worse coefficient. The specific calculation formula is as follows: the satisfaction index  $\text{Better} = (A+O)/(A+O+M+I)$  when having A certain function;  $\text{Worse} = (O+M)/(A+O+M+I) * (-1)$ .

It can be concluded from the ranking of Better results that the demand attributes with higher ranking are charm demand (0.62) and expectation demand (0.62), which indicates that the key to emotionalization is to form a mutually progressive interactive relationship between "packaging-product-user". Therefore, charm demand and expectation demand are the key elements of packaging emotional design. From Worse results can be concluded that the higher ranked requirement attributes for the expected demand (0.5) and (0.49), the basic demand also verified the user commitment to packaging brand reputation, consistent, and on the packaging on comfort, in is they have a strong negative effect, thus to foster strengths and circumvent weaknesses in the design, the design demand level is preferred.

## **4. Optimization of emotional sustainable packaging design based on user needs**

In the optimization stage of the design of the emotionally sustainable packaging, the functions related to the reverse demand should be avoided as far as possible. Secondly, to meet the basic needs, and strive to reduce the user's dissatisfaction; Thirdly, the importance of undifferentiated demand is degraded, and the resource input is appropriately reduced. From then on, the main energy will be focused on charm needs and desired attributes, balance desired attributes, optimize them in the appropriate interval, and take charm needs as the emotional drive to achieve the effect of design improvement. Finally, according to the characteristics of various demand attributes, the optimization direction of emotional sustainable packaging design based on user demand is proposed.

### ***4.1. Sustainable materials extend the "user-packaging-product" life cycle***

In the selection of packaging materials, designers take the impact of resources on the environment as

the most important design goal, which is reflected in the field of packaging design as follows : (1) from the sustainability of packaging materials; Balance life cycle, environmental impact, and social and economic development benefits through design; (2) The sustainability of the packaging life cycle. Based on the idea of life cycle assessment, the designer should not only consider the minimization of the environmental impact value of the packaging in the production cycle, but also consider the subsequent circulation, use and recycling. The life cycle of packaging can be extended through design intervention, and the discarded packaged goods can be rationally utilized. For example, Pepsi Light is a sugar-free low-calorie cola product under the Pepsi brand. The bottle body is designed into the shape of a dumbbell. Users will put different weights of materials (stone, sand, etc.) into the dumbbells according to their training requirements. The design not only highlights the image of health of the products, but also extends the life cycle of the products.

#### ***4.2. The multifunctional packaging structure strengthens the communication mechanism of "user-packaging-product"***

The emotional link between packaging and users is a continuous process. At present, most packaging is designed to be "used up and discarded" before the emotional link between packaging and users is established. How to maintain the mutual progress of "user-packaging-product" as long as possible is the focus of emotional packaging design research. The optimization direction are: (1) through the design of packaging structure optimization, such as the lamps and lanterns of ikea brand design, multi-function embodied in it is not only protect the bulb packaging, convenient transportation, at the same time it also has the combined with light bulb type chimney the multidimensional purposes, so it still after packaging apart as an integral part of the product. (2) Understand and meet users' needs during use to make people feel interesting. For example, the packaging of Medi Flower, which takes into account the pain points that patients don't want to take medicine, is designed in the shape of petals to bring users an interesting and comforting experience in the process of taking medicine.

#### ***4.3. Narrative design conveys the emotional experience of "user-package-product"***

Narrative is a way for human beings to understand and connect the world and construct identity. Narrative design is also the key to ensure the continuous emotional communication of packaging. The best way of narrative is that "user, package and product" complete the narrative process together, that is, interactive narrative. The higher the user participation in the narrative, the stronger the emotional link will be generated. For example, Nintendo's Switch Labo game component requires users to slowly assemble its products. During the process of participation, users get a continuous sense of achievement. Until the final product form is presented, users have established a stable emotional link with the packaging.

## **5. Conclusion**

Design is not only limited to the category of material design, but also needs to be transformed into emotional design. Emotional sustainable design is to delay the waste cycle of products by studying the emotional maintenance of "user-package-product", so as to eliminate waste fundamentally. In this paper, through continuous quantitative analysis of the Carlo model, based on user needs, the factors that determine emotional packaging are obtained, and the design optimization direction of emotionally sustainable packaging is proposed, so as to effectively improve and delay the life cycle of packaging and curb waste solutions.

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