The Application of Big Data Analysis to Assist the Design of Children's Food Packaging Experience Model

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Abstract. In the era of experience economy, the unchanging and boring packaging form has been unable to meet the emotional experience and psychological needs of consumers. Especially in the field of children's food products, packaging design should fully consider children's physical and mental characteristics. Traditional user experience research was with small sample size and underrepresentation. Big data features massive data and collects more dimensions of user data, which provides the possibility for personalized user experience design. To assist the design of children's food packaging experience model, this study explored a new method of big data analysis, through data collection, data cleaning and semantic analysis of big data from social media, with buzz from 2–10 year-old children's parents. A "utility-emotional two-dimension structure model" of children's diary packages was constructed, and 4 indicators from each dimension were identified to explain the impact of the packaging on user experience. This study explored how to supplement a user experience structure model based on social big data. The packaging design model could make children get more comprehensive experience, is conducive to promoting children's packaging and product purchase, is the future direction of emotional packaging design.

Keywords: Big data · Semantic Analysis · User Experience · Packaging Demand Mining · Children's Food

1 Introduction

1.1 Review of the User Experience

User experience, as a concept in the field of design, was first put forward by Donald Arthur Norman (2003), an American psychologist, and was then widely known by people. User experience is a purely subjective feeling made by users according to the convenience and practicability of the actual usage of the product. Usually we can understand it as the whole feeling of the user's interaction with the product, in addition to the immediate feeling during use, it also includes the user's cognitive expectations of the product before use and the influence after use.

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This study adopts the definition of user experience by Lucas Daniel (2000), that is, user experience refers to what users do, think and feel when operating a product or using a service, including rational value and perceptual experience provided to users through products and services. Mahlke (2005) believed that the evaluation method of user experience should integrate cognitive and emotional factors and take the evaluation of emotion as a part of the comprehensive evaluation method of user experience. Cognitive factors include technical factors of human-product interaction (such as ease of use) and non-technical factors (such as enjoyment, visual aesthetic perception and content attraction). Experience design also needs to put the concept of "people-oriented" as first priority, which is also the basis of modern product design.

1.2 User Experience Design Driven by Big Data

Traditional user experience research mainly focuses on qualitative or quantitative research with small sample size and underrepresentation. Big data features massive data and can collect more dimensions of user data, which also provides the possibility for personalized user experience design. Have to study and put forward, big data technology gradually applied in the field of user experience design, artificial intelligence technology and the technique of big data, will further expand the application range of user experience research, deep learning, cognitive, social computing, etc. New technology, will gradually solve the problems that traditional user experience research field can't solve. Therefore, big data analysis can effectively supplement traditional user experience research methods. Meanwhile, With the vigorous development of the Internet, a large number of social media users to their daily life behaviour records released on the Internet, these records is the natural reflection of users psychological characteristics and psychological activity, is rich in content, naturally occurring, size, easy to trace, etc., makes the social media platform like "online psychology laboratory." Through the analysis of users' online behaviour records, individuals' objective behaviours and subjective feelings can be understood in real time and on a large scale without interference from users, providing a new paradigm for the research and application of psychology. Big data-driven user experience design makes it possible to achieve the product design goal of "user experience as the center", and brings users a more intimate user experience, which is of great significance.

1.3 Research Status of Product Packaging Design

In modern society, people's demand for commodities shows a trend of personalization. Packaging design presented in simple forms such as images and texts can no longer bring users good experience services. Compared with traditional packaging design, interactive design research on product packaging from the perspective of user experience can better pay attention to the needs of users in many aspects. The interactive presentation of packaging design not only focuses on the embodiment of product "function", but also to the "experience" or "emotion" of the product. This interaction allows attracting more users and promoting sales.

For food, packaging design in interaction design, industrial design and service system design have the corresponding methodology and design principles proposed and

applied. Literature review shows that domestic and foreign researches on user experience are prosperous and fruitful, but there are few scholars involved in the researches on user experience evaluation applied to food packaging design, especially Children's food. Therefore, this article built the structure model of user experience evaluation on Children's food packing, based on the existing user experience model framework. The model will enrich the study of the theory of the user experience from the aspects of theoretical and empirical, and provide reliable reference for improving food packaging design.

2 Overview of the Measurement Dimensions

The evaluation of user experience is a process of quantifying user experience, which needs to decompose user experience that cannot be directly measured into measurable evaluation indicators. The construction of user experience model is the basis for systematic research and effective evaluation of user experience. The experience elements of packaging need to provide emotional value at the emotional level as well as functional value at the cognitive level. Refers to the cognitive level of experience design, the usability of the product, like whether easy to learn, easy to use, is the behaviour response under control of human brain consciousness, often worked as useful and easy-to-use product. The emotional experience design refers to the spiritual and psychological reflection of users, what kind of thinking brought to users, and the consciousness, thought and emotion generated by users through thinking, learning and induction.

This is consistent with the "User Experience Process Model" proposed by Sascha Mahlke (2005), who emphasizes the complex interrelationship between the cognitive part and the emotional response in user experience, and has a significant impact on the overall judgment, behavioural results, and emotional experience of the product. According to his theory, great experiences include not only objective aspects (such as product usability, ease of use), but also subjective aspects (such as visual appeal, user preferences, etc.).

Therefore, this study will make an attempt. Based on the user experience process model proposed by Sascha Mahlke, and referring to semantic analysis of social big data, a user experience evaluation model suitable for children's food packaging design was constructed. This study analyzed the hierarchical structure of user experience process from two dimensions of functional experience and emotional experience, namely "utility-emotional two-dimension structure model", and decomposed it into measurable indicators to explain the impact of children's food packaging on user experience. By deep diving of social big data content, it helps to understand the rationality and feasibility of the selection of user experience evaluation indicators, as well as the relationship and mechanism of each evaluation indicator and user experience.

3 Indicators Identification Based on Social Data Analysis

3.1 Big Data Collection

3.1.1 Data Crawling

Obtain consumer posting data on mainstream social platforms, including Weibo, through commercial API interface, data period is from December 2020. to November 2021. Identify target group of 2–10 year-old children's parents by their children's age labels or posts which help to identify children's age. Set diary packaging keywords (category, brand, packaging form, material, etc.) and extract content from the target group as original data.

3.1.2 Data Cleaning

Due to the large amount of data and various information, it is necessary to clean the data. The original data were de-watered and de-noised. Training set plus machine learning was used to identify accounts such as water army and zombies and remove their contents. Load the custom exclusion lexicon, remove punctuation marks and useless words, etc.

3.2 Semantic Analysis of Big Data

Biterm Topic Model (BTM) Model is adopted to cluster a large number of text related to keywords to acquire topics. Through cluster analysis, packaging content is clustered into multiple dimensions, such as appearance, sealing, etc. By using Natural Language Processing (NLP) technology, corpus entity recognition and emotion recognition are carried out.

3.3 Result

The results of cluster analysis of discussion Angle (Table 1) showed that appearance occupied the first place of the buzz volume, followed by portability, accounting for more than 20%. Dimensions of use experience and independent packaging accounted for more than 10% of the discussion, while dimensions of sealing, environmental protection and storage accounted for less than 10%. These dimensions effectively complement the functional and emotional design dimensions of the packaging experience model. And ranking of buzz share also indicated the importance of this dimension to some extent.

Through in-depth analysis of user experience, it is found (Table 2) that it contains multiple emotional dimensions, which provides a reference for the emotional experience dimension of children's packaging.

The most discussed three dimensions were selected: appearance, portability and use experience. Consumer's sentiment was analyzed by different packaging forms with the index of NSR (Net Sentiment Rate). Shown in Table 3, as for canned milk, NSR was high on appearance and portability, as for its premium look and strong protection. When it came to bottled milk, NSR was low on portability, mainly because glass bottles were heavy and fragile. When it came to boxed milk, the NSR of eating experience was high as it was more convenient for children to drink through straws. However, portability was

Table 1. Buzz share of discussion angles of children's diary package

Discussion Angles	Buzz Share	Ranking
Appearance	31.6%	1
Portability	23.4%	2
Experience during usage	15.3%	3
Independent package	11.5%	4
Sealing	5.3%	5
Environment Friendship	1.2%	6
Storability	1.1%	7

Table 2. Buzz share of discussion angles of experience during usage

Discussion Angles	Buzz Share	Ranking
Sense of fun	36%	1
sense of pleasantness	22%	2
Sense of development	2%	3

Table 3. Sentiment analysis of different package forms

		Can	Bottle	Box	Bag
Appearance	Positive (%)	73.3	58.1	57.1	76.4
	Negative (%)	7.9	15.1	10.0	16.6
	NSR (%)	80.5	58.7	70.2	64.3
Portability	Positive (%)	61.8	32.0	36.2	54.2
	Negative (%)	32.6	54.9	33.9	41.7
	NSR (%)	30.9	-26.4	3.3	13.0
Experience during usage	Positive (%)	81.8	77.6	95.1	67.7
	Negative (%)	3.0	3.7	3.3	7.3
	NSR (%)	92.9	90.9	93.3	80.5

more negative, as the box was easy to burst, and couldn't be renewed. As for bagged milk, the NSR of experience during usage was low, which came un-renewed drink.

$$\text{NSR} = (\text{Positive buzz\%} - \text{Negative buzz\%})/(\text{Positive buzz\%} + \text{Negative buzz\%}) * 100\% \quad (1)$$

$$\text{Positive (Negative) buzz\%} = 100\% * \text{Positive (Negative) buzz/Total buzz} \quad (2)$$

4 Structural Children's Food Packaging Experience Model

Childhood is the cognition and the preliminary stage of growth, it is of the fastest growing period of body and mind, children's food packaging design should fully consider children's physical and mental characteristics and cognitive development situation. In addition to the improvement of children's appreciation and aesthetic perception in appearance, it is necessary to combine the theory of children's cognitive development to provide children emotional interaction and humanistic care. Children's packaging design needs to show its humanized design on the premise of meeting children's cognitive needs and emotional pleasure.

4.1 Functional Experience Measurement

Functionality is a basic and important principle in packaging interaction design. It is an overall evaluation of usability and a quality indicator to measure product effectiveness, ease of use, safety and efficiency from the perspective of users. Cognition is the process of information processing. Jin Yan and other scholars believe that user experience is generated from users' cognition and perception of information and services and is greatly influenced by cognitive factors. For food packaging, it can make the food itself to maintain the stability of food quality, keep fresh from the factory to the hands of consumers. Specific indicators are shown in Table 4.

Portability. The consumption of each meal was small for children, and the time of eating was uncertain. Therefore, portable packaging is needed. Most of the early beverage packaging was made of glass, but the glass material was fragile and heavy, leading to easy damage in the process of transportation and usage, so the beverage packaging was mostly made of plastic in the later period. Consumer verbatim from social platform echoed*" This glass milk, while it looks healthy and safe, is too heavy to take out of the house"*.

Sealing. The safety of children's food is more important, so food packaging needs to have strong sealing. However, in view of the weak opening ability of children, it is necessary to design the product packaging for ease of use at the same time of high sealing. The design should focus on the rationality of the product opening way, convenience for children to take and operate, the operation process should not be too complicated. The opening part of the package can be designed with obvious logo, and has simple structure and easy operation function. Consumer verbatim echoed *"When choosing milk for my baby, I usually go for canned milk, which insulates the air well"*.

Environmental Friendship. The choice of packaging materials, all in the interests of children. Attention should be paid to the chemical stability and safety of packaging material and packaging structure. Disposable packaging causes waste of resources and

environmental burden. It is the development trend of modern traditional children's packaging design without pollution and can be degraded. It is also the new requirement of the country for green packaging in the future. For example, in children's packaging design, the packaging is designed as children's toys, which can continue to be used as building blocks after fulfilling the function of packaging; For example, on the inside surface of the children's packaging carton, there are signs indicating that the packaging can be folded into different handmade origami works. On the basis of meeting the basic functions of packaging, the optimization and expansion of children's food packaging design not only makes the packaging last longer, but also makes the interaction between the packaging and the child more complete.

Storability. To protect children's packaging products from damage due to human factors or force majeure factors in the process of production, transportation, storage and sales, the structure of packaging design should be more stable and easy to transport. It also helps to protect the goods inside, connecting to the needs of sealing.

4.2 Emotional Experience Measurement

Emotional experience is the internal and subjective mood and emotions generated by consumers when experience. It is the emotional precipitation formed in the heart through the interaction between objects and users. It emphasizes the emotional satisfaction and feedback generated by users in the process of use, which is an attitude experience of users on whether objective things meet their expectations. Positive emotional experience can keep users in an active state of thinking, effectively improve their understanding and cognitive level of information, and improve their recognition of information and services, so that users can have a good user experience. For children, it can be divided into aesthetics, interesting, educational and pleasurable indicators in Table 4.

Sense of Aesthetics. Aesthetics is a special emotion that people show to the things they observe or admire in aesthetic activities, and It is the emotional reaction of the consumers through the perception of the beauty of objective things. Children's packaging design should reasonably choose graphics, text, color, material texture and other sensory elements, according to children's aesthetic mood, such as the use of lively cartoon graphics, thunder-and-lightning colour, simple elastic, soft and exquisite packaging materials, so

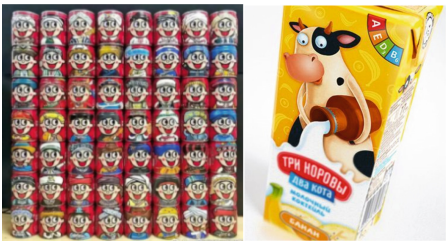

Fig. 1. Appearance design

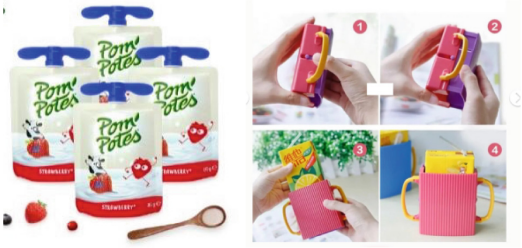

Fig. 2. Design for fun (left), pleasantness (right)

that children have an affective identification, user is willing to accept and use the product, and form a good psychological mark. Consumer verbatim from social data echoed *"Bought for my baby, all reluctant to drink, each jar has a different pattern, is very interesting, anyway, love it a lot"*. Some good examples were shown in Fig. 1.

Sense of Fun. Children's nature is close to nature, and children's abstract logical thinking ability is low, so we have to use very intuitive pictures, easy for them to understand. Children's world is innocent and happy, through the funny game to mobilize children's emotions, so that the product packaging design enables better communication with children. Children's nature is lively, some children's food packaging itself is a toy shape, can be used as a packaging toy, can also be used as a toy packaging, to bring strong games to children. In the packaging design of children's food, designers can consciously carry out personalized artistic processing of packaging graphics, make full use of graphics, color, modelling and other design languages to create packaging with formal beauty and fun, so that children can get psychological satisfaction and fun experience. Some good examples were shown in Fig. 2.

Sense of Development. It is necessary to design the packaging into a form that children can understand and be familiar with, and to add elements that can inspire children's intelligence in food packaging. Through the ingenious pattern puzzle design, origami design, graphic and text interactive games on the package, exercise children's hand-eye coordination ability and promote their brain development. Intelligent packaging design plays a role in coordinating body function through benign interaction between children and products. In the packaging design of children's food, designers can consciously carry out personalized artistic processing of packaging graphics, make full use of graphics, colour, modelling and other design languages to create packaging with formal beauty and fun, so that children can get psychological satisfaction and fun experience. Some good examples were shown in Fig. 3.

Sense of Pleasantness. Children's packaging design should make full use of children users' strong curiosity to stimulate their rich imagination and creativity, through narrative design and other ways to let children explore packaging and fully develop association, get spiritual satisfaction. Through children's opening and closing of packaging, experiencing the process of using packaging, they can feel the sense of achievement of using packaging

Table 4. Indicators of children's food experience model

	Indicators	Description
Functional Experience	Portability	Consider the amount of food children eat at each meal, proper packaging is easy to carry and use
	Sealing	Protect food from physical and chemical damage to keep food fresh, and also easy for children to tear the packaging
	Environment friendship	Take into account the physical fitness of children, packaging materials should be environmental protection
	Storability	Facilitate logistics transportation and sales management
Emotional Experience	Sense of aesthetics	Design the corresponding appearance and modeling according to children's cognitive characteristics
	Sense of fun	Make full use of graphic, color, modeling and other design languages to create both beauty and interestingness in form
	Sense of development	Add elements into the packaging that can inspire children's intelligence, to provide a certain educational significance
	Sense of pleasantness	Keeps children feeling good and cheerful throughout the eating process

Fig. 3. Design for children development

to obtain products and the satisfaction of learning skills, and obtain emotional identify, meanwhile avoid negative experience like messed up. Some good examples were shown in Fig. 2.

5 Conclusion

This study takes children's food packaging design as the specific research object to explore how to supplement a user experience structure model based on social big data. Based on user experience, it requires children's food packaging not only to be safe, practical, simple operation, but also to provide children with interesting and creative emotional experience. Combining with the characteristics of food packaging, the user experience is analyzed and evaluated from two different dimensions. From the perspective of functional experience, it involves sealing, environmental friendship, storage and portability. From the perspective of emotional experience, it involves sense of aesthetics, fun, development and pleasantness. Then the mechanism and indicators are discussed, so as to provide useful suggestions for children's food packaging design, so as to give children a comprehensive user experience.

Analysis of user experience design principle and method of the user experience of children as the center and starting point of the design considerations, according to the characteristics of children's physical and mental development to food packaging design, improve product identification, let the packaging in the form of more humanization, interactive and fun into the lives of consumers, to provide certain theoretical basis for design of children's food packaging, 2 dimensional experience packaging design can make children users produce more comprehensive experience, is conducive to promoting children's packaging and product purchase and brand likeness, is the future direction of emotional packaging design.

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