



Research on the Interactive design of Safety for Children's Food Packaging

Shang Cun^{1,2,a}, Xue Ying^{1,b}, Liu Wenxiang^{1,c*}

¹Xinyang Agriculture and Forestry University, Xinyang,464000, China

²Wuhan University of Technology, Wuhan, 430000, China

^a2006230019@xyafu.edu.cn; ^b2020290002@xyafu.edu.cn;

*Corresponding author.Email:leadnat@163.com

Abstract. Childhood is an important stage in life. It is very important to provide better food packaging design for children. Due to children's limited cognitive abilities, safety is a key factor to consider in food packaging for children. Safety provides an effective guarantee for children's food packaging to meet consumers' different needs for products. Based on the developmental characteristics and needs of children in childhood, this paper analyzes the safety design method of children's food packaging from the perspective of packaging design and applies NFC, near-field communication technology to interactive packaging based on children-experience. This paper proposes to use NFC technology to create emotional communication through the interaction between food and packaging so that the design of children's food packaging can truly and accurately convey its own value and design concept. Interactive communication between packaging and children groups should be constructed to carry out intelligent transformation and upgrading of barrier-free packaging, so as to better meet the two-way interaction between children groups and product packaging, and to realize the intelligent transformation of barrier-free packaging design. Establish the more appropriate concept of humanized safety design for the growth needs of childhood children in order to serve the groups of children.

Keywords: Children 's food, Food Packaging Design, Barrier-free package, NFC technology.

1 Introduction

According to the packaging design in the current market, some food packaging will contain small items, which are easily swallowed by children and cause respiratory obstruction, resulting in safety risks[1], and some food packages contain caps or corks that may easily twist off [2]. Some food packages contain liquids that can easily spill (if the liquid is too hot or too cold, it can easily cause children to be burned or frostbite) [3]. This has led to safety design issues in food packaging. As people pay more and more attention to the safety and health of children's food packaging, the safety opti-

mization design of food packaging is also paid more and more attention. This paper starts with an analysis of the psychological characteristics of children in childhood.

2 Childhood and food packaging safety

2.1 Childhood growth behavior and consumption characteristics

Childhood children refer to children aged 6-12. The age of consumer groups and the developmental characteristics and needs of physiological and psychological development are the first issues to be considered in the safety design of children's packaging. They are developing toward adulthood in terms of thought, psychology, character, and personality[4-8]. Children of different ages have different development characteristics, and there will be obvious differences in the specific needs of the design. Children in this age group usually receive primary education, so children mainly study. The cognitive ability and expression ability are approaching the level of adults. The ignorant memory also starts to turn into autonomous memory. Gradually, They have the ability to think logically, and the ability to judge and understand things based on their characteristics[9-10].

2.2 Food packaging

Food packaging is an integral part of food products. Its main function is to protect food, so that food from the completion of production until circulation to the consumer's hands process, preventing logical, chemical, and physical external factors damage, it also has the effective function of maintaining the stable quality of the food itself, it is convenient to eat food. Packaging can also be the most direct expression of the appearance of food, attracting the attention of consumers, with value beyond the material cost[11]. Therefore, food packaging is an integral part of the whole food sales process. Children's food packaging design is one of the important types of food packaging design. The interactive design of children's food packaging is one of the future trends. Interactive design is an interactive relationship between children's food, children's food packaging, and children. Children no longer simply taste food but create emotional communication through interaction with food and packaging, which is an experiential process. With the continuous development and maturity of NFC technology, its application scope is more extensive. The biggest advantage of this technique is that it is quick and easy to read the data at any time. In recent years, NFC technology has been widely used in packaging design.

2.3 NFC technology for food safety packaging interactive design

Interactive design can use new technologies to change children's interactive use behavior of packaging. They do not need to input any information. Parents only need to match the mobile App, and the product will make reasonable suggestions on children's physical and mental health based on their behavior and diet [12-13]. In the message,

there will be expert advice and animations reminding parents of the effects of the food on children. In this case, the application of NFC technology not only plays a role in food packaging, it can provide relevant suggestions for parents to buy products, but also increase the entertainment in the process of children's use.

3 Safety issues in children's food packaging

3.1 Packaging material factor

With the innovation and development of science and technology, packaging materials continue to bring forth the new. The criterion for judging the material is whether it is suitable for the consumer group of the product. Among the safety factors of children's food packaging, whether the packaging materials cause damage to human health is the first thing to be considered. Packaging made of plants and vegetables has been favored by designers and children. It can save raw materials, avoid the inconvenience caused by environmental pollution, and increase the added value of commodity packaging because of its unique shape. Beverage packaging and instant food packaging adopt biodegradable materials. Combining the biodegradable materials of packaging with the interactive design concept, this type of packaging can not only reduce environmental pollution through its own degradation but also be convenient for children to carry. Not harmful to children (Fig. 1).



Fig. 1. The packaging mouth is made of Biodegradable materials

3.2 Packaging structure factor

The structure design of the packaging is the main body of packaging design, but also the most can reflect the concept of interactive design, can realize the interactive relationship between packaging and children. The use of auxiliary components can also increase the additional functions of packaging and enhance the interaction between packaging and children. The application of the packaging auxiliary component is mainly a way to extend the original packaging structure, which is different from the packaging structure and cannot exist independently. The auxiliary component of packaging is a supplement to the functional defects and adds new elements to it, which solves the inconvenience brought by the original packaging form to the children group to some extent. It can complete the interaction by changing the existing way of packaging and the user behavior of the children group. Milk carton packaging, as shown in the figure (Fig. 2).



Fig. 2. The design of the Milk carton packaging structure has auxiliary component

3.3 Packaging image and text design factors

Children's preference for graphics is mainly based on children's recognition degree of graphics. Compared with early childhood and early school, children's preferences in childhood are more extensive. In addition to paying attention to cartoon images in TV, they will also pay attention to cartoon characters in the Internet and games. In the design of children's food packaging, it is necessary to show the distinctive characteristics of food cartoon graphics can deepen children's memory. The text on food packaging should meet the sensory needs of children because of the small number of words they can recognize, their limited reading ability, and their lack of ability to find useful information from complex words. Children's food has its product particularity, the use of text should be as simple as possible, highlighting the characteristics of easy recognition and visualization. In most cases, the explanatory text in packaging will not attract

the attention of children, but parents will pay more attention to the explanatory text for the safety of children. Complex text will destroy the overall beauty of packaging, so for the design of text, not only to let parents fully understand the product characteristics, but also to reduce the visual interference brought by text to children. As shown in the figure (Fig.3), the fruit with cartoon images can directly attract children's eyes, the cute font makes the package full of vitality, the main text is in the visual center of the whole package, and the cartoon characters in the package account for 50% of the package. All these designs are in line with children's visual characteristics.



Fig. 3. The position of image and text design

4 The Survey of Consumers' Cognition of Children's Food Package Safety Concepts

4.1 Survey sample selection

Using random sampling method, 250 questionnaires were distributed in Wanda Shopping Plaza and Walmart supermarket in Wuhan City, China, and random sampling survey was conducted via Internet mail. 250 questionnaires were issued and 210 valid questionnaires were collected. The response rate was 84%.

4.2 Questionnaire settings

This paper has three test questions, it is about awareness of the conception of children's food safety packaging, and whether it is necessary to add packaging information description to the packaging information.

4.3 Specific survey question design

The Children's Food Safety Package Concept Questionnaire mainly wants to investigate whether consumers understand the concept of children's food safety packaging, and the choices of answers are: know more, a bit more, incomprehension. whether it is necessary to add the packaging information to the children's food safety packaging information, the choices of answers is: very necessary, necessary, and indifferent.

4.4 Analysis of survey results

Through the investigation and analysis of the questionnaire, 15% of consumers choose to know more about whether they understand the concept of children's food safety packaging, 55% of consumers choose only some understanding, and 26% of consumers choose not to understand. In the question of the necessity of adding packaging information to children's food safety packaging information, the proportion that consumers choose is very necessary is 41%, the necessary proportion is 46%, and the indifferent ratio is 9%. In the above survey, it can be found that consumers have obvious needs in the introduction of packaging for children's food packaging. The questionnaire survey charts are shown in Table 1 and 2.

Table 1. The Problem of the concept in children's food safety package

	More understanding Only	some understanding	Don't understand
consumer choice	15%	55%	26%

Table 2. The survey whether it is necessary to add packaging material instructions to children's food safety package

	So much necessary	necessary	I don't care
consumer choice	41%	46%	9%

5 NFC technology is used for food packaging interaction

NFC Interactive packaging is used to embed passive NFC labels into intelligent food packaging for the initiating device to read and write information. Then, the mobile phone exchanged information with the NFC label through NFC function to complete the experience of interactive packaging. Information storage depends on another major component, the NFC chip, which realizes the functions of being read, writing information, and storing information by NFC mobile phone or other devices. There are usually four types of chips, and the characteristics of the four types of labels are shown in Table 3.

Table 3. Features of NFC tags of different chip types

Type	Representation	bytes	Communication Rate (kbits·s ⁻¹)	Read/Write Distance /cm	Read/Write Time /ms	Erasure life / 10000 times	Cost / (yuan·piece ⁻¹)
Type 1	Topaz 512	512	106	2.5~10	1~2	10	1.4
Type 2	Ntag 213	168	106	1~15	1~2	1	0.6
Type 3	FeliCa Lite-S RC-S966	252	106	<20	1~2	10	1.5
Type 4	Mifare Des- fire2K	2 K	106	2.5~10	1~2	10	4.5

6 The main means to solve the safety of children's food packaging design

6.1 Improved design of "barrier restrictions" for food packaging structure and appearance of childhood children

In the process of using children's food packaging, the first consideration is the safety needs of consumers. Because the child's thinking is still immature, the packaging will be used according to his own ideas. However, the operation of the child's hand is not careful enough, and the self-protection ability is weak, so there is a lack of reasonable judgment on safety in the use of packaging. In response to this problem, in order to avoid or prevent the disadvantages of the hand operation of the child when using food packaging, some restrictive means can be utilized to compensate for the defects in the use of the child. The so-called obstacle design refers to the intention to set certain obstacle elements in terms of product function, structure, material, etc., in order to improve the safety of the product itself by means of a " barrier " in operation and use [14-15]. The core of barrier design is to protect the safety of children, including the safety of producers and product users. In combination with the characteristics of childhood children's food, pre-set "obstacles" in the design ensure the safety of children's operation and product structure rationality. For example, in children In terms of improved design of the jelly packaging structure, some obstacles can be designed from the internal structure and appearance of the jelly, and the packaging can be improved into a packaging structure with a built-in straw device. When the child is eating, only a small portion can be taken, so that The act of extracting jelly is effectively limited, taking into account the safety of the children. Of course, the health and environmental protection of the built-in straw material is equally important. For a small cup of jelly, a spoon can be used as an auxiliary tool when the child is eating. Children use operations, which adds some complexity to the operation but effectively improves the safety of children.

6.2 Interactive communication between packaging and children

Interactive communication between packaging and children is constructed to realize the intelligent transformation of barrier-free packaging design. From the analysis of the big data environment, the connection between NFC technology and barrier-free packaging will be increasingly close. Interactive communication design establishes two-way communication between children and packaging information, a new consumption and transaction path. Through a mobile terminal as a carrier, the interaction between product packaging and children and their parents can be established to achieve barrier-free intelligent transformation. Intelligent terminals are used to achieve the interactive function of packaging information content "presented in the form of cartoon animation", break through the restrictions of children's vision, hearing, and other aspects, and strengthen the communication of multiple information of product packaging. For example, Near Field Communication (NFC) technology can provide interactive information exchange for children and parents. From the analysis of the big data en-

vironment, the connection between NFC technology and barrier-free packaging will be increasingly close[16].

7 Conclusion

Children's food packages and children's food safety are equally important to influence children's health and food safety. Therefore, it is necessary to consider the safety of consumers in the design of children's food packages. The choice of package materials, The use of appropriate methods of barrier design, and the establishment of safe and humane design concepts for the psychological characteristics of children in childhood can create food packaging that is safe and attractive for children, in order to better serve the children's community, while still being practical and convenient for adults. Choose non-toxic and environmental protection packaging materials to reduce the adverse impact on the environment; Use a spill-proof design to prevent spills of children's food during transportation and storage to reduce the risk of contamination; Decorative design to avoid small parts that pose a choking hazard to children, including small toys or decorations attached to packaging; In the design and use of easy-to-read labels to improve the legibility, easy for children to understand, convenient for parents to better supervision of children's food. At the same time, considering that the regulations and standards for children's food packaging safety vary from country to country around the world, the requirements of relevant laws and regulations should also be taken into account when designing the safety of children's food packaging. The use of appropriate methods of barrier design and the establishment of safe and humane design concepts for the psychological characteristics of children in childhood can create food packaging that is safe and attractive to children, and still practical and convenient for adults.

ACKNOWLEDGMENTS

This work was supported in part by the Visiting scholar of of Wuhan University. Training Program for Young Backbone Teachers of Xinyang Agriculture and Forestry University and the Innovative Research Team of Traditional Village Conservation and Regional Culture Research in Xinyang Agriculture and Forestry University(2022KICX021).

REFERENCE

1. Ming-Chyuan. Lin, Ming-Shi. Chen, Yi-Hsien. Lin, Yu-Ching. Hung, A User-Centric Evaluation Procedure for the Design of Child-Resistant Medicine Bottles. *Human Factors and Ergonomics in Manufacturing & Service Industries*, vol. 25, Wiley, New York, 2014, pp. 211-227.
DOI: <https://doi.org/10.1002/hfm.20595>
2. Gaurav Kr. Deshwal, Narendra Raju. Panjagari, Review on metal packaging: materials, forms, food applications, safety and recyclability, *Journal of Food Science and Technology*, Springer, Berlin, Heidelberg, 2019, pp.1-16.

DOI: <https://doi.org/10.1007/s13197-019-04172-z>

3. N. De Kruijf, M. Van Beest, R. Rijk, T. Sipiläinen-Malm, P. Paseiro Losada & B. De Meulenaer, Active and intelligent packaging: applications and regulatory aspects, *Food Additives & Contaminants*, vol. 19, Taylor and Francis Group, Boca Raton, 2002, pp. 144-162. <https://doi.org/10.1080/02652030110072722>.
4. Lu. Shizhen, Wei. Zhaopeng, Hu.Wei, Introduction to Chinese children's policy, Social Sciences Academic Press, 2005.
5. H. Rudolph Schaffer, Introducing child psychology, Publishing House of Electronics Industry Press, 2016.
6. Zhu. Zhe, On packaging color design psychology for children in childhood, *Packaging Engineering*, vol. 9, China national knowledge internet, beijing, 2009, pp. 183-185. DOI: 10.19554/j.cnki.1001-3563.2009.09.063
7. Yang. Ning, The child as father of man-The essence of human childhood from the perspective of evolutionary psychology, *Journal of South China Normal University*, vol.5, China national knowledge internet, beijing, 2003, pp. 107-113.
8. Liu. Rong, Research on the ingenious design of children's food packaging, Hunan University of Technology Press, 2015.
9. Zhang. Qing, The study on the snack consumption of Chinese children and adolescents and the role of snacks, Zhengzhou University Press, 2008.
10. Ouyang. Yifei, Wang. Huijun, Wang. Dantong, Snacking food pattern among Chinese children and adolescents in twelve provinces, *Journal of Hygiene Research*, vol. 6, China national knowledge internet, beijing, 2016, pp. 868-875. DOI: 10.19813/j.cnki.weishengyanjiu.2016.06.002
11. Zhang. Xiaomei, Research on the design of children's food safety packaging, Nanchang University Press, 2009.
12. Triggs, R. What is NFC & How Does It Work? 2014. Available online: <https://www.androidauthority.com/what-is-nfc-270730/>
13. Sun, S.; Zhang, F.; Liao, K.; Chang, V. Determine factors of NFC mobile payment continuous adoption in shopping malls: Evidence from Indonesia. *Int. J. Bus. Intell. Res.* 2021, 12, 1–20. DOI: 10.4018/IJBIR.20210701.oa1
14. Yuan. Enpei, Zhu. Pengyang, Research on the barrier-free design of children's food packaging, *Packaging Engineering*, vol.6, China national knowledge internet, beijing, 2013, pp. 1-4 DOI: 10.19554/j.cnki.1001-3563.2013.06.001
15. Cai. Yushuo, Ways to solve the problem of packaging safety for children's products, *Packaging Engineering*, vol.2, China national knowledge internet, beijing, 2014, pp. 77-80 DOI: 10.19554/j.cnki.1001-3563.2014.02.020
16. Hatem. El. Matbouly, Fatemeh. Nikbakhtnasrabadi & Ravinder. Dahiya, *Biosensing and Micro-Nano Devices*, Springer, Berlin, Heidelberg, 2022, pp. 219–241. DOI: https://doi.org/10.1007/978-981-16-8333-6_9

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

