

**MULTI-SENSORY FACTORS IN CONSUMER'S  
PRODUCT PACKAGING BARRIER FOR THE  
ELDERLY: A CASE STUDY OF CHONGZUO  
CITY, CHINA**

**GANFANG**

**UNIVERSITI SAINS MALAYSIA**

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by

**GANFANG**

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## LIST OF ABBREVIATIONS

et al.	et alii
ISO	International Organisation for Standardization
CNKI	China National Knowledge Infrastructure
2D	Two-dimensional
3D	Three-dimensional
CQs	Choice Questions
MCQs	Multiple-choice questions
CRC	Child-resistant Cap
JEPeM	Human Research Ethics Committee of USM
QR	Quick Response Code

## **LIST OF APPENDICES**

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**FAKTOR- FAKTOR PELBAGAI DERIA DALAM HALANGAN  
PEMBUNGKUSAN PRODUK PENGGUNA UNTUK WARGA EMAS: SATU  
KAJIAN KES DI KOTA CHONGZUO, CHINA**

**ABSTRAK**

Selaras dengan statistik yang menunjukkan peningkatan penduduk yang semakin tua di China, reka bentuk bebas halangan yang dihasilkan untuk warga tua telah menjadi perhatian industri reka bentuk. Walaupun halangan pembungkusan sering menjadi isu dalam kehidupan seharian warga tua, kajian berkenaan isu ini masih kurang dilakukan. Terutama, ciri-ciri penting reka bentuk pembungkusan deria yang dapat memudahkan warga tua untuk menggunakan pembungkusan tanpa halangan. Walau bagaimanapun, kerja penyelidikan secara kolektif berkaitan faktor-faktor deria dalam reka bentuk pembungkusan adalah terhad kepada segmen pemasaran yang disebabkan oleh pemahaman yang tidak menyeluruh. Kajian ini bertujuan untuk menilai bagaimana faktor-faktor deria dalam reka bentuk pembungkusan yang boleh menyelesaikan halangan pembungkusan yang dihadapi oleh warga tua. Bagi mencapai tujuan, kajian ini terlebih dahulu telah mengenal pasti halangan pembungkusan yang dihadapi oleh warga tua dan sebab-sebab halangan tersebut, seterusnya menganalisis fungsi-fungsi pembantu faktor-faktor deria dalam reka bentuk pembungkusan berdasarkan halangan pembungkusan yang dihadapi oleh warga tua. Penyelidikan ini menggunakan kaedah penyelidikan kualitatif untuk menjalankan kajian kes di bandar penuaan tipikal Chongzuo, China. Berdasarkan data yang diperolehi daripada kajian literatur, tinjauan soal selidik, dan sesi temu bual bersama warga tua dan pakar, halangan pembungkusan seperti berikut telah dikenal pasti: 1) halangan kepada pengenalan maklumat produk, 2) halangan untuk mengetahui cara membuka

bungkusan, dan 3) halangan untuk membuka bungkusan. Seterusnya, sebab-sebab terperinci halangan pembungkusan tersebut dikelaskan kepada beberapa kategori seperti berikut: 1) ciri-ciri warga tua dan 2) ciri-ciri pembungkusan. Berdasarkan halangan pembungkusan yang dihadapi oleh warga tua dan data yang dianalisis, faktor-faktor deria yang berkesan adalah penting dalam reka bentuk pembungkusan untuk 1) menyampaikan maklumat produk, 2) membimbing kaedah membuka pembungkusan, dan 3) memudahkan pembukaan pembungkusan untuk warga tua. Selepas membincangkan penemuan kajian, faktor-faktor deria dalam reka bentuk pembungkusan yang berkesan untuk menyelesaikan halangan pembungkusan yang dihadapi oleh warga tua telah dinilai. Hasilnya, satu set faktor pelbagai deria yang berkesan dicadangkan oleh kajian ini untuk membangunkan reka bentuk pembungkusan bebas halangan yang sesuai untuk warga tua.

**MULTI-SENSORY FACTORS IN CONSUMER'S PRODUCT  
PACKAGING BARRIER FOR THE ELDERLY: A CASE STUDY OF  
CHONGZUO CITY, CHINA**

**ABSTRACT**

As the statistics indicates a high ageing population in China, barrier-free designs formulated for the elderly have been a concern in the design industry. Although encountering packaging barriers has been a common issue in the elderly's daily life, studies that address this issue are insufficient. Notably, the significant features of the sensory packaging design can facilitate the elderly to use packaging without barriers. However, the collective research work on sensory factors in packaging design is limited to the marketing segment due to incomprehensive understanding. The purpose of this research is to evaluate how sensory factors in the packaging design solve packaging barriers for the elderly. In order to fulfil this purpose, this research first identified the packaging barriers encountered by the elderly and reasons that led to those obstacles; then analysed the assistant functions of sensory factors in the packaging designs based on the packaging barriers encountered by the elderly. This research employed qualitative research methods to conduct a case study in a typical ageing city of Chongzuo, China. According to the data retrieved from literatures, questionnaire surveys, as well as interview sessions with the elderly and experts, the following packaging barriers were identified: 1) barriers to product information identification, 2) barriers to knowing how to open the package, and 3) barriers to opening the package. In addition, detailed reasons that caused those packaging barriers were classified into the following categories: 1) the characteristics of the elderly and 2) the packaging features. Based on the identified packaging barriers

encountered by the elderly and the analysed data, effective sensory factors are crucial in the packaging designs to 1) convey product information, 2) guide the packaging opening method, and 3) facilitate packaging opening for the elderly. After discussing the study findings, sensory factors in packaging designs that effectively resolved the packaging barriers encountered by the elderly were evaluated. As a result, a set of effective multisensory factors is proposed in this study to develop barrier-free packaging designs suitable for the elderly.

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 Introduction**

This study sought to evaluate how sensory factors in packaging design solve packaging barriers encountered by the elderly. It was anticipated that the knowledge generated from this research would provide an in-depth understanding of elderly packaging barriers, broaden the research scope for sensory packaging design, and afford new insights into barrier-free packaging design. Based on participatory research of elderly people, this research employed qualitative case study methodology to understand packaging barriers and develop solutions.

This chapter begins with the research background and context to draw the research problem and purpose. Following this is the research objectives, questions, contributions and significance. The chapter ends with a discussion of the research delimitation, terminology definitions, and thesis organisation.

### **1.2 Background and Context of the Study**

The research background of this study is based on the characteristics of China's ageing population, the development status of solving packaging barriers and sensory packaging design.

#### **1.2.1 The Ageing Population in China**

As stipulated in Article 2 of the People's Republic of China Law on the Protection of the Rights and Interests of the Elderly, individuals over the age of 60 are classified as the elderly group (Ministry of Civil Affairs of the People's Republic of



China, 2019). China's ageing population presents three main characteristics: 1) the number of the elderly population is growing rapidly over the years, 2) the ageing phenomenon is serious in developing cities and regions, and 3) more and more elderly people choose an independent lifestyle. These characteristics enable the life quality of the elderly in their later years has been a concern across all social strata.

### **1.2.1(a) Rapid Increment of the Elderly Population in China**

China is the only country with over 100 million elderly people residing there (260 million). The China Census Bureau published in May 11, 2021 revealed that the proportion of China's 1.4 billion population aged 60 and above was 18.7% (China Bureau of Population Statistics, 2021). China is also recorded as the country with the fastest growing rate of the ageing population in the world (Mark, 2020). From 2010 to 2020, the fraction of the population aged 60 and above increased by 5.44 percentage points (China Bureau of Population Statistics, 2021). When compared with the past decade, the rate had increased by 2.51 percentage points (China Bureau of Population Statistics, 2021). The vast population base and rapid growth rate make the elderly population become an essential social group that cannot be ignored in China.

### **1.2.1(b) The Phenomenon of Ageing Population in Developing Cities of China**

Population mobility makes the ageing phenomenon more evident across developing regions and cities of China. Referring to the distribution of population emigration across areas and regions from the seventh census, developing cities and regions (particularly counties and villages) were the main areas where the young population moved out (China Bureau of Population Statistics, 2021). The young

generation chose to work and live in developed cities when they were still young and would return to their developing hometowns when they grew old. Since the population moving out mainly involved the young generation and the population moving back was predominantly middle-aged and elderly people, apparent ageing is observed across developing cities.

The Chongzuo city was selected to conduct a case study in this research, primarily because it is a severely ageing and developing city. Based on the five aspects of commercial resource agglomeration, urban hub, urban people's activity, lifestyle diversity, and future plasticity; the New First-tier Cities Research Institute (Urban Data Research Institute of China Business News Weekly) had rated 337 cities in China, in which Chongzuo was ranked the fifth-level city (the lowest level) (New First-tier Cities Research Institute, 2020). The hierarchy of the city indicates its progress. The first level is the most developed cities, while the fifth level refers to cities that require development in China.

In China, an ageing city is a city where more than 7% of the urban population is above 65 years old, more than 10% is over 60 years old, and less than 30% is under 14 years old (Liang, H, 2018). Referring to the seventh national census in 2021, the resident population of Chongzuo city was 2,088,692 (Office of the Leading Group for the Seventh National Census of ChongZuo, 2021). Looking at the age structure, 0-14 years old accounted for 20.91%, 15-59 years old accounted for 61.14%, 60 years old and above accounted for 17.95%, and 65 years old and above accounted for 13.25% (Office of the Leading Group for the Seventh National Census of ChongZuo, 2021). These data show that the city of Chongzuo has been significantly ageing. In addition, as a small southern city, Chongzuo has two types of elderly people moving in -

homecoming personnel upon retirement and the elderly from other cities. Since the warmer southern city of Chongzuo is suitable for retirement to avoid the cold winter (Miao, 2011; Wang, 2015).

Therefore, the main reasons for the ageing of Chongzuo city are: 1) the underdevelopment of the city causes young people to move out to developed cities to seek development opportunities, 2) the middle-aged and the elderly return to their hometowns, and 3) the elderly from northern areas choose southern cities for retirement.

### **1.2.1(c) Many Elderly People in China Choose to Live Independently**

The Shell Research Institute (a data company) survey in China revealed that 65.5% of the elderly lived independently (alone or with spouse), while the fraction of the elderly living with their adult children had gradually decreased (Ren, 2021). Patterns of independent living among older adults reflected two reasons. First, the different living habits of the two generations cause the elderly to dislike living with their adult children. Second, the young adults move to developed cities and leave their elderly parents to live independently in their hometowns.

### **1.2.2 Design Concepts of Solving Barriers for Users**

Whether the objects used for the daily living pose as barriers are directly related to the quality of life of the elderly. Based on the barriers encountered by the disabled and elderly people, design concepts dedicated to assisting them to solve the barriers have been initiated by the design industry.

The barrier-free design concept is the most direct and the first to be proposed to overcome barriers for users via design. The concept of barrier-free design originated in the United States in 1950 (Oliver & Christine, 2010; Persson et al., 2015; Satoshi, 2021). As the World War II caused some American soldiers to become physically inconvenient groups, environmental designs (building & equipment) were initiated so that disabled soldiers can obtain education, participate in employment, receive medical services, and live an independent living (Oliver & Christine, 2010; Persson et al., 2015; Satoshi, 2021). This barrier-free design initially focused on those with disabilities, so as to help them address various barriers due to limited physical functions and impaired mental functions (Oliver & Christine, 2010). The causes of disability are congenital, injury, and the natural ageing process (Oliver & Christine, 2010). Therefore, the fundamental concept of barrier-free design facilitates all vulnerable groups so that each person can use the specially-designed objects independently (Oliver & Christine, 2010).

Several other design concepts of solving barriers for users have emerged from the barrier-free design concept, including design for all, universal design, inclusive design, and accessible design (Persson et al., 2015; Satoshi, 2021). This is because; barriers are not limited to the disabled, but those affected by poor design (Satoshi, 2021). Some designs are barrier-free for a group of people, but a hindrance for another group.

The European Institute for Design and Disability defined 'design for all' is to achieve inclusiveness and equity in design by meeting the diverse needs of different users during their 2004 annual general meeting held in Stockholm (Mira, 2004). The 'universal design' concept, which was initiated by Ronald L. Mace (an architect,

product designer, & educator) refers to designing objects that should be universal to users with different ages, physical abilities, and using conditions (Springer Link, n.d.). The concept ‘inclusive design’ is primarily applied in the United Kingdom and denotes that the design should include as many user groups as possible on a global scale so that users can use the design object in different use environments (Normie, 2005). Meanwhile, ‘accessible design’ is devoted to expanding the potential user base by making the design object as easy to use as possible for certain groups with performance constraints (ISO, 2001).

A common point of these design concepts that derived from the barrier-free design concept is to enable each individual to use the designed object without barriers. As a result, the definitions of these design concepts can be converged despite their slight variance. The meeting held in 2009 among the European Union Ministers viewed terms ‘barrier-free design’, ‘inclusive design’, and ‘design for all’ as converging with the term ‘universal design’, which was applied in the meeting document (Persson et al., 2015). These design concepts are meant to increase the accessibility of the interactive system for design objects to gain the broadest possible range of user groups.

The emergence, evolution, and formation of these design concepts of solving barriers for users result from the continuous efforts of various organisations and individuals. These design concepts reflect that individuals, societies, countries, and the whole world are gaining higher awareness of the necessity for everyone, including the elderly and the disabled, to better integrate into the society.

Particularly with the increasing ageing population across the globe, solving barriers for the elderly is essential. Since designs for other age groups may not be

accessible to the elderly, while designs for the elderly are definitely accessible to users of other ages (Nigel & Lynne, 2015). More importantly, the design for the elderly signifies the future of every non-elderly group, which will continue advancing as people from various backgrounds and cultures enter the old age phase.

### **1.2.3 Packaging Design under Design Concepts of Solving Barriers for Users**

Packaging barriers users encounter have led scholars, researchers and designers to introduce solving barriers design concepts into the packaging design field. Packaging designs under the design concepts of solving barriers for users refer to packaging designs that adhere to the concept of barrier-free design or similar design concepts, such as universal design, inclusive design, accessible design, and design for all deriving from barrier-free design. Its aim is to provide barrier-free packaging design for users, particularly for the elderly and the disabled.

Studies concerning barrier-free packaging design are limited, even though issues related to packaging barriers are a concern to many international organisations and packaging researchers worldwide. The International Organisation for Standardisation (ISO) has substantially contributed to the standardisation of the world's barrier-free packaging design. This organisation has successfully compiled and published a series of standardised documents for barrier-free packaging design. In light of the research projects and studies on solving packaging barriers via design, barrier-free packaging opening designs have garnered the most attention as the research subjects.

### **1.2.3(a) Packaging Design Standards under Design Concepts of Solving Barriers for Users**

The International Organisation for Standardisation (ISO) is an independent non-governmental international organisation with 165 national standard bodies that bring together experts to share knowledge and formulate international standards related to the market in order to support innovation and provide solutions to global challenges (ISO, n.d.). The ISO has published four authoritative international standards for packaging design that cater to a range of contents and aspects under the accessible design concept.

In 2011, the ISO issued ISO 11156: 2011 Packaging — Accessible design — General requirements (the latest applicable version after a review in 2017). Upon considering the entire lifecycle of packaging products; from product identification to use, this document outlines the general standards for barrier-free packaging design. Its goal is to enable a wider range of user groups to recognise product information on the packaging and use packaging, including the elderly and people with weak sensory, physical, and cognitive functions (ISO, 2011).

In 2015, the ISO promulgated ISO 17480: Packaging — Accessible design — Ease of opening (the latest applicable version after a review in 2020) to enhance the convenience of package opening from an accessible design stance. This international standard, which is based on users, covers all aspects of package opening design (i.e., open positions, open methods, & evaluation techniques) (ISO, 2015).

In 2017, ISO 19809: Packaging — Accessible design — Information and marking was introduced to outline the precautions and methods for presenting

information and markings in packaging design (ISO, 2017). Apart from the display of product information on the package, this document stipulates the opening information on the package. By considering the sensory and cognitive abilities of end users, people with the broadest abilities can obtain packaging information effectively (ISO, 2017).

In 2019, the ISO released ISO 22015: Packaging — Accessible design — Handling and manipulation, which lists requirements and recommendations to enhance the accessibility of packaging to be handled and manipulated in accordance to the physiological capabilities of a wide range of users. This standard weighs in the packaging needs of multiple user groups with varying capabilities in different use environments (ISO, 2019). Size, shape, structure, weight, material, and opening methods of the package are recommended for easier package handling and manipulation (ISO, 2019).

As a world-class authority, a series of barrier-free packaging design standards published by ISO is adopted by countries worldwide. Besides, it has guided scholars, researchers, and designers from different countries to study and promote barrier-free packaging design research work under its exclusive standards and specifications. At the same time, scholars' research and findings in the field of packaging barrier-free design are constantly enriching and improving these packaging design standards.

### **1.2.3(b) Packaging Design Studies under Design Concepts of Solving Barriers for Users**

Studies on solving packaging barriers are scarce, with only 12 articles identified in English through search keywords of 'packaging design' containing 'barrier-free design', 'design for all', 'inclusive design', 'universal design', and



'accessible design'. Among these 12 articles, 3 looked into product information identification barriers and packaging opening barriers, while the other 9 articles focused on solving package opening barriers. This shows that studies on solving other packaging barriers are in scarcity, when compared with studies on package opening barriers. In addition, 9 articles out of them clearly stated that the purpose of the research is to make the elderly use the packaging barrier-free, which means that packaging barriers generally exist among elderly users.

Three articles offered solutions to both product information identification barriers and packaging opening barriers. Scholars from Thailand, Chana Yiangkamolsing, Erik LJ Bohezl and Ingo Bueren (2010), proposed barrier-free design principles for flexible packaging based on the 'universal design' concept: the packaging information should be reasonably designed and easy to understand; and for packaging opening, they point out that everyone should open the packaging in a convenient, simple, and safe way. Next, Maria Lilian de Araújo Barbosa, Gisele Yumi Arabori Ribeiro, Isabel Gebauer Soares, and Maria Lúcia Okimoto studied tactile product information and opening settings in the packaging design to enable visually impaired users to identify packaging information and open the packaging both by touch (Maria et al., 2019).

Another study that looked into solving both product information identification barriers and package opening barriers for users was conducted by the scholar team of Dr Alaster Yoxall. They shared their inclusive packaging design viewpoints in a book entitled 'Integrating the Packaging and Product Experience in Food and Beverages'. Their article emphasised on the importance of considering a wide range of users in packaging design, especially to enable users with limited vision and hand abilities to

recognise product information and open the package effectively (Goodman-Deane et al., 2016). As a significant player, Dr Alaster Yoxall from Sheffield Hallam University has been involved in inclusive packaging design for over 12 years (Sheffield Hallam University, n.d.). He has made outstanding contributions to this field in cooperation with some researchers and has influenced other researchers to do similar research in other regions.

Dr Alaster Yoxall and his collaborators had published the most research findings regarding package opening barrier-free design through their contribution of five academic papers. Based on the ‘inclusive design’ concept, they conducted a series of studies on package opening requirements and elderly hand abilities. They proposed a barrier-free package opening design for the elderly by incorporating engineering design and biomechanical elements to balance the relationship between package opening requirements and elderly hand abilities (Alaster, Victor et al., 2019; Langley et al., 2004, 2005a; Langley et al., 2005b; Canty et al., 2005).

Next, Marcin Butlewski - a scholar from the Poznan University of Technology - published a similar study as Dr Alaster Yoxall and his research team, except that the latter deployed the ‘universal design’ concept instead of the ‘inclusive design’ concept. The research background, content, and conclusion are reflective of each other. It was also based on the background of ageing to achieve barrier-free packaging for everyone by striking a balance between the engineering mechanics required to open the package and the biomechanics of the hands of the elderly (Marcin, 2015).

Meanwhile, the other 3 academic articles looked into barrier-free package opening based on ageing. Scholars of Jeeranuch Buddeejeen and Athakorn Kengpol pointed out that when compared with the package opening text prompt, the package

shape can better help the elderly understand the package opening methods and open the packaging effectively (Jeeranuch & Athakorn, 2018). Next, Woodcock, Torrens, and McDonagh adopted the 'design for all' concepts and assessed if the food packaging can be opened by elderly individuals with positive or negative mentality (Woodcock et al., 2002). They further claimed that the barrier-free package opening design can help the elderly with weaker physical capabilities to lead an independent life (Woodcock et al., 2002). Another study proposed user-friendly packaging designs concept for daily consumer product centred on user needs, so that the elderly, patients with rheumatism, and those with visual impairments can open the packages effectively (Jensen & Widding, 2009).

#### **1.2.4 Packaging Design under Design Concepts of Solving Barriers for Users in China**

The concept of barrier-free design was not formally put forward in China until 1985. At this time, the concept of barrier-free design has been developed for 35 years since it was proposed in 1950. Similar to the initial application of barrier-free design in the United States, the concept of barrier-free design in China was initially applied to the public environment and amenities for physically challenged groups.

In a seminar held in March 1985 entitled 'Disabled Persons and Social Environment', the Third Session of the Sixth National People's Congress, and the Third Session of the Sixth National Committee of the Chinese People's Political Consultative Conference held in April 1985, discussions were actively carried out on making public facilities accessible to a wide spectrum of groups (China Rehabilitation Research Center, 1989). These three national-level meetings identified and initiated

the design of barrier-free environments (buildings & equipment) for physically inconvenient groups in China.

Notably, the germination and formation of China's barrier-free packaging design concept appear to be influenced by the international barrier-free packaging standards, as well as the evolution of barrier-free design concepts that derive from the Europe and the United States. This is because; the barrier-free design concept and other concepts that stemmed from it (i.e., accessible, universal & inclusive design concepts) were all initiated by scholars and institutions in the Western countries.

#### **1.2.4(a) Packaging Design Standards under Design Concepts of Solving Barriers for Users in China**

Based on the series of barrier-free packaging standards issued by ISO, the State Administration for Market Regulation and the National Standardisation Administration of China had translated and formulated the following series of barrier-free packaging design standards for China:

1) Packaging — Accessible design — General requirements (The State Administration for Market Regulation and the National Standardisation Administration of China, 2019);

2) Packaging — Accessible design — Ease of opening (The State Administration for Market Regulation and the National Standardisation Administration of China, 2015);

3) Packaging — Accessible design — Information and marking (The State Administration for Market Regulation and the National Standardisation Administration of China, 2020).

Since these standards are translated from the packaging barrier-free design standards published ISO, their main content is not repeated here (see detail in 1.2.3-a Packaging Design Standards under Design Concepts of Solving Barriers for Users). These comprehensive and national-level standards specify the overall design, the information design, and the opening design of barrier-free packaging design for China.

#### **1.2.4(b) Packaging Design Studies under Design Concepts of Solving Barriers for Users in China**

Many studies have attempted solving packaging barriers via design in China. In fact, 27 such articles were listed on China National Knowledge Infrastructure (CNKI) – China’s largest and most authoritative academic resource base (CNKI, n.d.). Similar to the studies written in English (see details in 1.2.3-b Packaging Design Studies under Design Concepts of Solving Barriers for Users), these studies that look into solving packaging barriers in China have begun adopting the concepts of barrier-free, universal, and inclusive designs. These articles were classified into four types.

##### **1) Theoretical Research on Solving Packaging Barriers Design Concepts:**

After learning the design concepts of barrier-free, this type of studies combined the requirements and principles of packaging design to arrive at effective solutions that overcome packaging barriers encountered by users (Liu X, 2016; Zhao Z, 2014). For instance, Liu Yi from the Hunan University of Technology integrated multi-aspects of packaging design to propose a barrier-free packaging design by analysing product information identification, package opening, and removing the items from the inside of the package (Liu Y, 2012).

Another study by Zhiyuan Jia from the Beijing Institute of Technology, which considered the disadvantaged groups and consumer packaging as the research objects, carried out three packaging case practices design based on ‘universal design’ concept learning, and finally, summarises several barrier-free design experiences from the packaging design practice study (Zhiyuan, 2016). Although many shortcomings, this kind of research has laid a theoretical foundation for introducing the concept of barrier-free design into the packaging design field in China.

## **2) Solving Product Information Identification Barriers for the Visually-impaired Group:**

In this type of research work, product information design is the research object, while suitable font, colour, graphic, and typesetting are used to design easy-to-identify information in light of the barrier-free packaging design concept (Ji, 2020; Ji, 2016). These studies concentrated on the visually-impaired groups for pharmaceutical packaging. By embedding tactile information (He, 2012; Zhao, 2014) or even developing intelligent systems provides voice information (e.g., mobile phone application) to assist the visually-impaired population gain important product information (Tian, 2020). Since the research group is the visually impaired, this type of research work tends to combine high technology with packaging design to achieve barrier-free information transmission, contributing to intelligent packaging design and study in China.

## **3) Solving Packaging Barriers for the Elderly:**

Studies that solve packaging barriers for the elderly are the most substantial with the publication of 15 research documents. The need for barrier-free packaging design is evident among the elderly in China as they often encounter packaging

obstacles in their daily lives. These studies focused on solving barriers to product information identification and package opening encountered by the elderly in terms of research content. The packaging samples were mainly consumers of pharmaceutical and food packaging.

Nine articles assessed and proposed solutions to both product information identification barriers and package opening barriers encountered by the elderly (Guan, 2020; Li, 2016; Liang, 2015; Liu & Liu, 2021; Liu, 2016; Tao, 2018; Wang, 2020; Xiaohui, 2021; Xun, 2021). Based on the physiological characteristics of the elderly's vision degradation, these studies addressed product information identification barriers encountered by the elderly by emphasising key text information, high colour contrast, easy-to-understand graphics, and reasonable typesetting design. Referring to the physiological characteristics of the elderly's decreased hand strength and flexibility, these studies overcame the package opening obstacles encountered by the elderly by simplifying the package opening method and rationalising the packaging structure.

Next, three articles solved package opening barriers encountered by the elderly. Xie Xinyi and Men Delai from the South China University of Technology conducted a similar study as of Dr Alaster Yoxall's research team and Marcin Butlewski (see details in 1.2.3-b Packaging Design Studies under Design Concepts of Solving Barriers for Users). After measuring the size and grip strength of the elderly's hands, they proposed that the opening design of the drug packaging for the elderly should consider the functional status of the elderly's hands so that senile patients can use these packages without obstacles (Xie, 2017). Another study took the design of drug bottle mouth as the research object. By assessing the current design status of most drug bottle mouths, as well as analysing the psychological and physiological characteristics of the

elderly, Yuan Huihui and He Ge solved the obstacle of package opening for the elderly by optimising the bottle mouth design (Yuan & He, 2020). The third article addressed the package opening barriers for the elderly by investigating the package opening settings of the packaging design case proposed by the brand product of Yang Feng Tang (Yang, 2013).

The remaining four studies on pharmaceutical packaging solved product information identification barriers encountered by the elderly. Based on the visual and cognitive characteristics of the elderly, all the studies solved product information identification barriers for the elderly through rationally designing the font, colour, graphic, and typesetting of the visual elements on the packaging (Fu, 2016; Huang, 2021; Liu, 2015; Liu & Liu, 2021).

The top limitation of these prior studies on solving packaging barriers for the elderly in China was the low participation of the elderly. In fact, 11 out of the 15 articles drew their research outcomes from theoretical study and discussion, as well as case analysis of packaging design practice. By amalgamating the theoretical knowledge of the physiological degradation state of the elderly, packaging design principles, and barrier-free design principles; several solutions to packaging barriers were proposed. Besides, some assessed excellent packaging on the market and turned its design advantages into a solution to packaging barriers encountered by the elderly. In short, these prior studies put forward some conceptual viewpoints to build a theoretical foundation for devising packaging barrier solutions for the elderly in China. However, the authenticity of these conceptual views lacks verification by the elderly participation.

#### **4) Application of Multisensory Design to Solve Packaging Barriers:**



Two theses related to this research topic were identified, namely: ‘The Development and Application of Multisensory and Barrier-free Packaging Design’ (Liang, 2012) and ‘A Study on Universal Packaging Design based on the Theory of Multisensory Concept’ (Gong, 2014).

The first thesis summarised some sensory packaging design principles so that a wide range of users can better gain the product information displayed on the packaging. It analysed the principle of information reception for special and healthy groups, the way of multisensory information communication and presentation, as well as some packaging design cases that were good at converting product information.

Next, the second thesis analysed the multisensory synaesthesia information expression. It exemplified some packaging design cases that applied vision and touch (Braille) factors to convey product information, along with the use of colour and packaging material to communicate product taste information. Finally, synesthesia's advantages in the barrier-free packaging communication information design are summarized.

Essentially, the two theses provided solutions that enable users to receive product information indiscriminately through sensory factors in the packaging design. These theses are new attempts that combined sensory packaging design with packaging barrier-free information transmission. They portray the feasibility of using sensory factors in the packaging design to address product information identification barriers for users.

### **1.2.5 Sensory Packaging Design**

Five senses (vision, hearing, touch, taste, & smell) are commonly used simultaneously by humans to interact with the external world. The use of sensory factors in packaging design stimulates one's five senses through packaging design elements to gain a better user interaction experience (Carlos & Charles, 2019). Hence, the packaging industry has placed its focus on the interaction between packaging sensory factors and users' senses called 'Sensory Packaging'.

Sensory packaging is mainly designed for consumer packaging. Packaging design derives from product needs, while sensory packaging design arises from marketing demand. Simply put, sensory packaging emerges from sensory marketing that is devoted to understanding how different sensory elements guide consumers' perception, judgment, and consumption behaviour in brand marketing and communication (Aradhna, 2012; Bertil, 2011). Brand uniqueness allows merchants to pursue differentiation from other similar brands in the market. As one's daily experiences are multisensory (Hellström et al., 2004), brands strive to create multiple experiences through multiple senses (Michael, 2014). Not limited to visual experience; auditory, olfactory, tactile, and taste factors have been used to enrich consumers' brand experience (Klaus-Peter et al., 2018). Product packaging is an essential medium that affects consumers' purchase behaviour (Jan et al., 2010; Ruth et al., 2014). Thus, businesses have begun employing sensory packaging to create a multisensory brand product experience.

The sensory packaging design was officially proposed in 2006 at the 6th ProCarton Conference held in Germany with the theme 'Multisensory Brand, Multisensory Packaging' (Li, 2008). The conference highlighted that stimulating the

five senses of users through packaging design elements can better convey information, increase sensory experience, and promote the sales of branded products. This notion has laid the leading tone for ensuing research work and practices regarding sensory packaging design to service brand products commercially.

The introduction of sensory packaging design in China is regarded as a panacea to increase consumer brand loyalty and brand product value (Industrial Design, 2008; Wu, 2013; Zhang, 2014; Zhongming, 2021; Zhu, 2013). Sensory packaging is used to attract consumers (Li, 2008; Wang, 2015; Wang, 2016; Zhang, 2015), create pleasant sensory interaction and experience for consumers (Gao, 2018; Liu, 2021; Zhang, 2014), as well as promote product sales (Gao, 2018; Li, 2017; Li, 2008; Wang, 2015; Wu, 2013; Zhang, 2015; Zhu, 2013) by stimulating the senses of the consumers (Chen, 2011; Liu, 2021).

Therefore, the significant features of sensory packaging are communicating information and creating experiences through the interaction of packaging design elements with one's five senses. Sensory packaging that communicates information via multisensory factors breaks through the mode of ordinary packaging that heavily depends on visual elements to convey information. The multisensory communication mode is consistent with the way people perceive the external world and can better meet information needs sought by users. This multisensory experience expands the packaging design from the original visual design activity to other sensory fields. Of particular concern is the tactile experience that runs through the entire packaging use process, similar to the visual experience. A user's multisensory experience in the packaging design that hinders him or her from facing packaging obstacles during use can create a good interaction between users and packaging.

The research domain of sensory packaging design mainly serves the market at this stage despite its significant features for the whole process of packaging use and the potential to aid users in using packaging without barriers. Based on the sensory packaging design studies prior to 2019, Carlos Velasco and Charles Spence edited an authority book entitled ‘Multisensory Packaging-Designing New Product Experiences’. In light of the future of multisensory packaging design, they clearly pointed out that the specific needs of the elderly in terms of packaging availability should be weighed in with the emerging ageing era (Carlos & Charles, 2019). Therefore, this present study is a prospective study of this future research path to evaluate how sensory factors in the packaging design solve the packaging barriers encountered by the elderly.

### **1.3 Problem Statement and Research Purpose**

The rapid growth of the elderly population and the independent living patterns of the elderly in China have drawn attention to the life quality of the elderly. Some barriers in daily life directly determine the quality of life among the elderly. Since the coexisting relationship between packaging and daily products makes packaging crucial in all aspects of people’s lives, packaging barriers encountered by the elderly must be given serious consideration. Nevertheless, studies on solving packaging barriers for the elderly in China are insufficient.

The service object of the design is users. Following the natural pattern that people use their five senses to interact with the external world together, the interaction between design and people can be better achieved. The sensory packaging design is precisely that kind of design. However, the current research on sensory factors in packaging design is meant for marketing products. Actually, the significant features of

sensory packaging design that communication information and create experiences through multi-sensory can be applied to meet the needs of the elderly to packaging use without barriers. Although the two theses had assessed the intersection of sensory packaging design and barrier-free packaging design, the studies are limited to barrier-free communication of product information and the study population was not aimed at the elderly population.

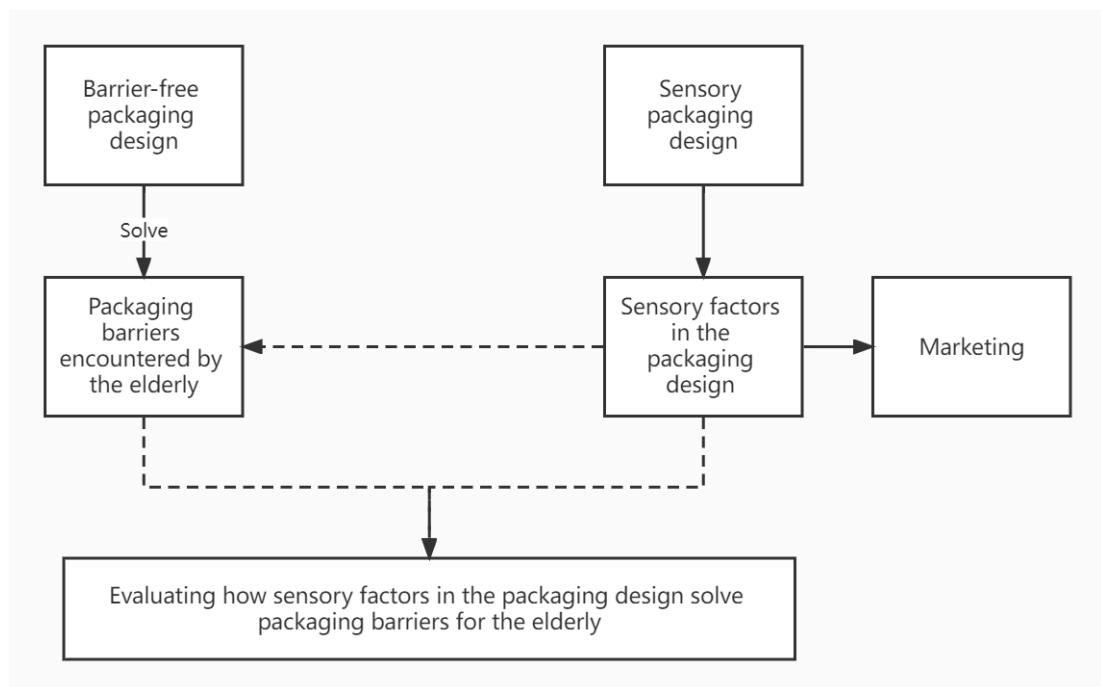


Figure 1.1 Problem statement and research purpose

As such, this study is the intersection of barrier-free packaging design and sensory packaging design (see Figure 1.1). Its purpose is to evaluate how sensory factors in the packaging design solve packaging barriers encountered by the elderly from the perspective of older participants. This also bridges the research gap in solving packaging barriers encountered by the elderly in isolation. Next, this study assessed the incorporation of multisensory factors in the packaging design that can simultaneously overcome multiple packaging barriers encountered by the elderly, thus allowing them to use packaging without barriers in a wide range.

#### **1.4 Research Objectives**

The research objectives of this study are listed as follows:

- 1) Identify packaging barriers encountered by the elderly and the reasons that cause the packaging difficulties;
- 2) Analyse the assistant functions of sensory factors in the packaging design based on the packaging barriers encountered by the elderly;
- 3) Evaluate how sensory factors in the packaging design solve packaging barriers encountered by the elderly.

#### **1.5 Research Questions**

The research questions formulated for this study are given in the following:

- 1) What packaging barriers are encountered by the elderly and the reasons that cause the packaging difficulties?
- 2) What assistant functions of sensory factors in the packaging design can solve packaging barriers encountered by the elderly?
- 3) How do sensory factors in the packaging design solve packaging barriers encountered by the elderly?

#### **1.6 Research Contributions and Significance**

The knowledge engendered by this study contributes to the research domains of elderly packaging barriers, sensory packaging design, barrier-free packaging design, and the elderly population's independence of life.

### **1.6.1 Contribution to Elderly Packaging Barriers Study**

First, through participatory research of the elderly population, this study identified the packaging barriers encountered by the elderly and the corresponding detailed reasons. A comprehensive analysis of the causes of packaging barriers offers a better understanding of packaging barriers and provides a basis for solving packaging barriers. It can make up for the lack of elderly participants in data collection, analysis, and verification in the research on packaging barriers for the elderly in China by providing an in-depth understanding of the current issues. Based on this research, other researchers can gain a better understanding of the current packaging barriers encountered by the elderly in China, and then further study the packaging barriers of the elderly in depth or breadth.

### **1.6.2 Contribution to Sensory Packaging Design Study**

Next, this study analysed the assistant functions of sensory factors in packaging design based on the packaging barriers encountered by the elderly. This is the innovative point of this study. The sensory packaging design has so far been deployed for service marketing due to limited understanding of its significant features. As such, this study explored the assistant functions of sensory packaging design to meet the needs of barrier-free packaging use for the elderly. Concurrently, this innovative study is also forward-looking research on future sensory packaging design proposed by Velasco and Spence in their book entitled 'Multisensory Packaging-Designing New Product Experiences' (Carlos & Charles, 2019). Essentially, this study inspires other researchers to conduct similar research work to solve the packaging barriers for the