Elderly-Centered Packaging Design Exploring Methods and Principles based on User Needs and Accessibility

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Abstract:

The elderly are becoming increasingly common in society as a result of the ageing population. As they age, their physical capabilities deteriorate, requiring the attention of several disciplines, particularly designers. Stakeholders in the design industry have paid close attention to the myriad difficulties older individuals encounter on a daily basis. Understanding older packaging obstacles and related causes is the aim of this study. This study looked at suggestions for packaging design that will assist senior citizens in designing products that are easy to use and accessible. The study's interactive approach yielded valuable insights on how people interact with packaging. The study was further informed by a combination of focus group data, both quantitative and qualitative. Semi-structured interviews were used to look at specific links between 2D and 3D User Centred Design indicators that don't seem to have been taken into account before. The study yielded fresh information on how older adults employ a combination of 2D and 3D hints while opening packaging. Four different kinds of information should be shown for package opening by combining 2D and 3D hints. These include 1) hand positions, 2) hand movements, 3) hand instructions, and 4) confirming the successful opening of the container as well as the method for opening it. Three distinct categories of indicators should be supplied: 1) to thoroughly describe how to open a box, 2) to evoke older people's past knowledge of comparable techniques, and 3) to give specific details related to opening a package.

1. Introduction

Ageing populations are growing at a never-before-seen pace. The World Health Organisation predicts that by 2030, one in six people on the planet would be 60 years of age or older [1]. As a result, the elderly population has grown in importance as a market for consumer products. Manufacturers may get a competitive advantage from products created with this customer segment in mind. This is required as ageing causes older adults to lose strength and dexterity, which is detrimental to their daily activities. Elderly people may experience cognitive deterioration as they age. Their interactions with packaging are influenced by all of these factors. There are many different types of packaging available on the market. However, what follows is just as significant: in order to use the product, customers must handle it independently. Because the contents of containers must be conveniently accessible to everyone, regardless of age, gender, handicap, or medical condition, human-package interactions should be investigated [2].
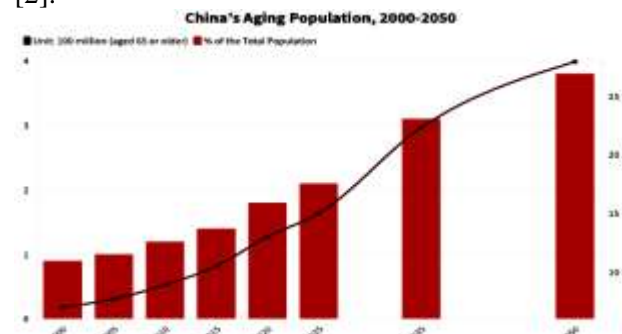

Figure 1. *China's demographic pyramid is changing due to rising life expectancy.*

According to United Nations figures 1, the number of Chinese citizens over 60 increased from 267.37 million (or 18.8 percent of the overall population) in 2021 to 280.03 million in 2022. From 3.6 percent in 1960 to 11.96 percent in 2020, the population 64

and older has grown at an average yearly rate of 2.36 percent.

When 10% of the population is over 60 or 8% is over 66, it is generally accepted internationally that a nation or area is experiencing an ageing society. The world's population is rapidly ageing, and this trend is expected to rank among the most significant societal developments of the twenty-first century [3]. According to the UN study on global population ageing, the number of persons over 60 is predicted to increase by 55% between 2015 and 2030, from 900 million to 1.3 billion, and by 2050, the number of old people worldwide is predicted to more than double from 2015 to around 2.2 billion. (Figure 1) While social progress and technical advancements continue to become "new," the world's demographic structure is becoming "older," and social phenomena are progressively reflecting the divide between the digital and ageing societies [4].

An ageing population will undoubtedly have a significant effect on the consumer market and present both new opportunities and difficulties for product packaging development. However, some companies just care about the food's health, disregarding the elderly food packaging's humane design [5]. Even when the old open these meals, there are safety risks. In order to meet the material and spiritual needs of the elderly consumer groups, as well as to increase product awareness and loyalty, the ageing perspective of the elderly food packaging open requires humanised design. This means paying more attention to the physiological, psychological, and behavioural characteristics of the elderly and making sure that the elderly food packaging is safe to use before, during, and after the humanised design was implemented. In order to increase product awareness and loyalty, This article focusses on the current issues with packaging in the market, which is based on the growingly dire state of ageing in Chinese society [6]. It covers the problems brought on by the physical and mental deterioration of the older population as well as their current situation. Key ideas for barrier-free package design that is suited to the requirements of the senior population are then presented in the article. This paper's study area is China, and its design scope entails developing comparable solutions based on pertinent research findings to produce a line of senior-friendly food packaging.

In order to create packaging for the elderly, it is necessary to resolve the conflict between the necessity for easy opening for the elderly and the need for effective sealing brought about by transportation technology and health standards. For some product categories, such medications, opening the container must primarily prevent youngsters from opening it by mistake. This is a major barrier for those with lower manual handling abilities, including the elderly. Another issue with the extensive usage of thermoplastic materials for packaging is the potential for ruining the cap's thread in bottle-type containers and the higher accuracy required for repeated closures. Closure components like caps must be small in size owing to material conservation and environmental regulations, which restricts the usage of grip strength and raises the necessity for squeezing strength. This is why a variety of frequently incompatible design principles should be taken into account while creating packaging. Additionally, since they are not the only users of the product, design for the elderly entails design for everyone while also taking their requirements into consideration.

Key Contribution of this Study:

- This study aims to identify and address issues in packaging design for seniors, focusing on improving the ageing process and directing creative processes. It includes strategic design creation, packaging research, and user-based research. The research enhances barrier-free pack ageing design and addresses geriatric packaging obstacles.

- In order to identify indications based on the senses that are employed to comprehend suggested meanings, we proposed 2D and 3D User Centered Design in this study. Surface, embossed, or imprinted indicators that users can see and read to decipher meanings are referred to as two-dimensional indications (2D).

- An engraved arrow, a graphic, or written directions are a few examples of these indicators. Shape, embossed, or imprinted indicators that users can see and feel to decipher messages are referred to as three-dimensional (3D) indications.

- The form of a trigger, ridges surrounding a lid, or imprinted markings that match between the lid and the packing body are a few examples of these indicators that point to an open package. Since the significance of an embossed arrow is received by sight rather than touch, it is classified as a 2D signal. Since the significance of the imprinted patterns can be sensed by touch, they are regarded as 3D indicators.

2. Literature Review

The Author [7] investigates package design that is age-friendly in order to solve issues related to ageing. It provides a thorough reference for real-

world application by employing a methodical evaluation of ideas and practices. The project is to improve the standard of living for senior citizens and support further study and application. TRIZ concepts are used in this study to solve overflow, pouring, and residual difficulties in elderly-friendly food packaging. It demonstrates its potential for commercial competitiveness by creating pouch-based packaging with a universal design [8]. In this study [9], five instances from mid- and large-sized businesses are examined to examine patient centricity in pharmaceutical package designs. It draws attention to difficulties and lessons discovered, stressing the necessity of a business case that balances stakeholder engagement, medication development timelines, and patient demands. According to a study of 5485 senior citizens in China, the most prevalent house modifications were railings and non-slip flooring, with over 30% of respondents requiring these features. These needs were linked to age, education, and degree of support. According to the report, in order to fulfil the general demand for house renovations, customised programs are required [10]. China's aged care policy has changed throughout time to uphold pension policies, enhance services, and safeguard the rights and interests of senior citizens. There are still issues, nevertheless, such as fragmentation, poor efficacy, and implementation hurdles. Expanding benefits, encouraging collaboration, bolstering government leadership, and improving employee training should be the main objectives of future initiatives [11]. According to a Chinese survey [12], handrails and non-slip flooring were the most frequent house improvements required by over 30% of older persons. These needs were linked to age, education, and degree of support. Programs that cater to the needs of the most vulnerable are required. The evolution of commodity packing forms is examined in this article, along with the development of media and the function of art philosophy in using artistic components to communicate ideas and feelings [13]. In order to optimise barrier-free package design for the elderly, this study examines the ageing Chinese population. It recommends packaging that is people-oriented, taking into account both mental and physical traits, in order to offer ease, safety, and humanistic care [14].Pop-top cans are simple to use, however elderly people may find them difficult to utilise. According to a research, different age groups have distinct opening techniques, which highlights the necessity for packaging designers to take into account the demands of all age groups [15].This study [16] addresses the problems of difficult and unidentified opening and suggests simple food packaging for the senior population, taking into account their physiological and psychological requirements.

3. Methodology

3.1 Identifying The Packaging Needs of The Elderly

The main problems during packaging opening include strength, handling, and information. Elderly people may have limitations in sense of touch, increased pain threshold, and sensing pressure points, which can cause skin abrasions and cuts. The design of opening systems should consider factors like maximum force required, grip type, opening possibilities, and the ability to improperly apply and spoil screw threads. Universal design principles should be used to develop detailed rules for individual parameters, with accepted values set at the 10 or 15 percentile of the oldest users.

3.2 Older People, Packaging and Users Accessibility

In order to attract the customers and present the quality of the goods, packaging design is essential. Safe closures shield contents and keep kids from unintentionally accessing them. However, due to physical deterioration and a lack of knowledge about opening mechanisms, elderly individuals may have trouble opening packaging. According to the UK Department of Trade and Industry, opening was a contributing factor in 39% of packing incidents in 1994, with older users being more vulnerable. Design strategies that improve opening ability while taking hand and sensory impairments into account are well-established. Understanding how to open packaging is not directly covered in previous study on the cognitive aspects of opening ability, which focusses on emotions, attitudes, and memories. Creating an effective package opening for older persons was not included in CEN/CENELEC Guide 6, which recommended characteristics of opening indications for older people.

3.3 2D & 3D User-Centered Design

It usually takes both hand and finger strength and movement to open a box. Therefore, difficulties may arise from physical limits related to hand strength or dexterity. However, other steps must be taken before a box is physically opened, such as gathering information from the package and considering how to open it. As a result, the three main steps in opening a box might be 1) getting the information, 2) deciding how to open it, and 3)

actually opening the package. Sensory organs are used as a single route for information input in the initial stage. The last step, when the box is physically opened, follows the second stage, which has to do with cognition.

Sensory Function
When opening packaging, the senses of touch, sound, and vision are involved. The following three sensory functions are affected, and this might have a negative impact on older adults' comprehension of how to open a package:
- Hearing sensitivity;
- Tactile and pressure sensitivity;
- Visual acuity, colour perception, and brightness and darkness adaption

Reading, particularly small type, might be challenging if one has declining visual acuity, colour perception, auditory sensitivity, tactile sensitivity, and pressure sensitivity. While ringing or buzzing sounds may impair hearing perception, high colour contrast is required to discern signals on packaging. There may also be a decline in tactile sensitivity, which deals with an object's form and texture, and pressure sensitivity, which deals with an object's hardness or softness.

Intellectual Processes
Intellectual processes include perception, memory, and understanding. Perception involves examining sensory stimuli, while memory helps classify old and new information. Understanding involves integrating old and new information, constructing ideas for decision making, and using experiences for future packaging use. These cognitive processes vary by author and can be used for various purposes.

Observation
Observation is expected to deteriorate due to age-related impairments in hearing, seeing, and touching.
Accordingly, older adults need more potent sensory stimulation. Larger font sizes and strong colour contrasts between the text and backdrop, for instance, will make it easier for senior citizens to follow written instructions.

Hand Functions
Physical deterioration of hand structures, muscles, tendons, and bones, as well as osteoarthritis and rheumatoid arthritis, which affect elderly people's joints, cause a loss in hand functions.
These disorders impair hand strength and make mobility challenging by causing discomfort, oedema, stiffness, and deformity of the fingers.

Older People's Design and Inclusive Design
This research excludes those with serious disabilities, such as blindness, and focusses on inclusive design for packaging for the elderly. Packaging for a larger customer base can be designed using the design suggestions. In inclusive design, where users are regarded as co-designers, user-centered and participatory design are crucial components. According to the study, elder consumers' participation as co-designers in the design process is essential to ensuring that packaging satisfies their demands and makes up for their deteriorating physical, cognitive, and visual abilities.

User-Centered Design
Users' needs are the focus of designers at every step of the iterative design process known as user-centred design (UCD). UCD design teams use a variety of research and design approaches to involve users in the design process, resulting in highly accessible and useable products for users.
The four stages of the User-centered Design (UCD) methodology include comprehending the user's context, determining needs, creating solutions, and assessing results. In order to comprehend consumer demands, determine their context, and evaluate the design's effectiveness, designers collaborate in groups. Until the assessment findings are satisfactory, the team goes through these processes again.

Key Components of User-centered Design:
- Visibility: Customers should be able to know right away what the product is about, what they can accomplish with it, and how to utilise it.
- Accessibility: Information should be simple and quick for users to locate. They should have access to a variety of information-finding tools, such as menus, search choices, action buttons, and calls.
- Readability: The text should be simple to understand. It's that easy.
- Language: In this context, short phrases are ideal. The simpler the wording and expression, the better.

User-centered design principles :
A number of fundamental ideas underpin User Centred Design (UCD), which guarantees that the final product satisfies the requirements and expectations of its users. The following are the main ideas:
Pay attention to users' needs: A thorough grasp of the requirements, habits, and motivations of users should inform design choices. This entails using

research techniques like surveys, interviews, and observations to interact directly with people.

- Iterative Design Process: UCD uses an iterative approach to product testing, prototyping, and refinement. Every iteration aids in discovering usability problems and implementing the required fixes in response to user input.
- Design for the Whole User Experience: UCD takes into account the complete user experience, which includes how consumers engage with the product in different settings and circumstances, in addition to the interface.
- Participation of Users During the Design Process: Users' input should be consistently sought and included from the very beginning of the design process. This guarantees that the design will always be in line with their requirements and preferences.
- Use of Research and Data-Driven Decisions: Information gathered from user research and testing should support design choices. This reduces presumptions and guarantees that the design is based on actual user requirements and habits.
- Inclusive and Accessible Design: UCD principles place a strong emphasis on creating products that are usable by everyone, including people with impairments. This entails following the rules and regulations on accessibility.

3.4 Participatory Design Methods

Three phases were used to gather data from participants: focus groups, in-depth interviews, and preliminary observations.

Starting Observations

The purpose of the study was to determine how the diminished capacities of older adults impact their daily activities. Ages 80+ and 60+ who participated in two lunch clubs showed impairments in their short-term memory, mobility, hand dexterity, hearing, and eyesight. Their capacity to open packaging may be impacted by these restrictions. Participants in the study were divided into age groups, and it was shown that older adults are more reliant and susceptible. Additionally, the researchers discovered that opening skill is correlated with prior understanding of packaging and indications.

Concentrate Groups

The purpose of the focus groups was to identify design requirements that would increase the intelligibility of package indications for older people.

Participants

Twenty one members of the Centre for Applied Gerontology's Thousand Elders3 were chosen for two focus groups, six of whom were female and six of whom were male, representing three age categories (65-74, 75-84, and 85+).

Packaging Samples

The study's main goal was to create signs that clearly explain to senior citizens how to open new packaging, particularly for home and food items.

Because plastics offered the widest range of opening techniques and indicators, they were the most widely used package materials. The study categorised and indexed the link often observed in various types of existing supermarket packages, looking at packaging with an unusual relationship of indicators to opening procedures. Focus groups were conducted using packaging that had a different connection from the categorisation index. Of the 23 packaging samples that were picked, 13 different kinds of opening techniques were used; the sample that looked the most distinct from the packages in the categorisation index was selected. Six of the 13 samples were randomly selected for focus groups, while the other seven were utilised for in-depth interviews so order to prevent grumpy elder people. These samples were thought to offer a realistic depiction of daily life for the study, unlikely to be impacted by various selection standards. Figure 2 displays the six samples.

There were two focus groups. The first group talked about the package that the participants found the simplest to open. In contrast, the second group talked about the package that its members had the most time understanding how to open. These two packages were determined using the average score value that participants submitted for the comprehension element. To determine the score, participants were instructed to attempt opening the same six package samples. As a result, every participant got firsthand experience opening the package sample that was later chosen for debate. Figures 2(a) and 2(d) above show the packaging samples that are the simplest and most challenging. There is a sun spray bottle in package 2(a). This package may be opened in two steps: 1) turn the white collar clockwise or anticlockwise to release the trigger lock, and 2) push the trigger to dispense the contents (see Figure 3b).

A bottle of tablet Container is included in package 2(d). There are two steps involved in opening this package: 1) taking off the base seal (see Figure 4a) and 2) pushing the lid to release the contents (see Figure 4b). Figure 5 displays 2D and 3D indicators on the chosen packaging samples utilised in the focus groups.
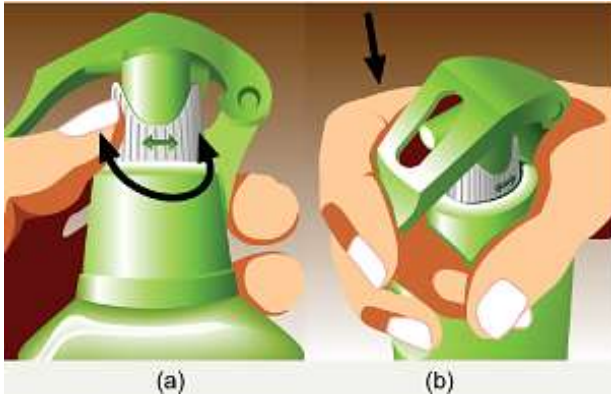
Figure 2. *6 package design samples.*

Figure 3. *(a) The white collar may be rotated clockwise or anticlockwise and (b) To distribute the contents, push the trigger.*
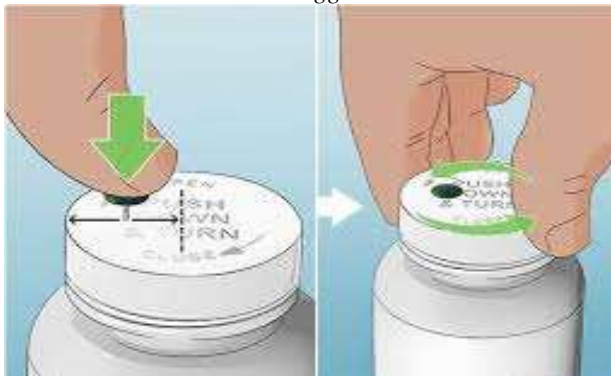

Figure 4. *(a) Taking off the package's bottom seal and (b) To discharge the contents, push the lid.*

Figure 5. *2D and 3D indications on the packaging samples*

4. Results and Discussion

4.1 Sensory Functions

According to the study, the visibility of cues is the most important design guideline for sensory functions. Colour, size, placement, design layouts, and typography may all help achieve this; however, don't put indicators on slick surfaces. Because of the restricted space on packaging, 2D signs, like textual instructions, are frequently minimal. Large and small sizes are available for 3D indicators, with location and colour contrast having a greater effect on visibility. Design layouts and typography may make lengthy instructions simpler to comprehend, and indication size has a greater impact on visibility than size. The visibility and readability of 2D indicators are adversely affected by shiny surfaces. According to the study, elderly adults who might have trouble seeing or reading signs should be given alternate forms.

4.2 Intellectual Process

Important design suggestions for enhancing package information comprehension were uncovered by focus groups. These included outlining the process for opening packaging, ranking the information that needed to be opened, and connecting indicators to the necessary opening techniques. According to the study, prejudices and past experiences have an impact on how older adults read instructions on how to open packages. Participants may be misled by familiar packaging looks, which facilitates comprehension. To assist older individuals grasp how to open innovative packaging that uses new opening techniques, more indicators are required.

4.3 Hand Functions

Older adults' physical opening abilities are impacted by the design of package, therefore unnecessary hand motions should be avoided. Users should be able to open package using opening mechanisms in accordance with indications. Indications can successfully direct participants in some situations, but opening mechanisms could be challenging. Further investigation is required in in-depth interviews, and the use of 2D and 3D hints is essential in directing comprehension of how to open packaging.

Figure 6 displays 2D and 3D indicators on the chosen package samples utilised in the in-depth interviews.

The researcher explained to the participants in the focus groups and in-depth interviews that the goal

of having them attempt to open the packaging samples was not to assess their ability to do so, but rather to get their feedback in order to create design suggestions for packaging that takes into account older people's opening abilities. In order to make the surveys easier for participants to read and complete, careful consideration had to be given to the page layout, font, and type size.

Figure 6. 2D and 3D indications on the selected packaging samples used in the in-depth interviews.

5. Discussion

The results from the in-depth interviews indicated that 2D and 3D suggestions were used to help participants understand how to open the package samples. The signals can be categorised into three classes according to the kind of information they provide.

- Group 1 has 2D full explanation indications (textual instructions and diagrams, for example), which include all the hand positions, motions, and directions required to open and confirm the correct approach to open packaging.
- Group 2 focusses on 2D and 3D memory trigger indicators (such product names and atomisers), which employ users' prior knowledge to recognise opening procedures and show the appropriate hand positions,

actions, and directions for opening the lid and/or dispensing the contents.

- 2D and 3D partial explanation signs (such as arrows and indentations) fall under Group 3. These indicators partially reveal information about how to open a package, such as the locations of hands and the actions required to remove the lid, but they do not provide instructions.

Diagrammatic Examination of 2D and 3D Indications Used in Package Opening

Figure 7 shows the several kinds of 2D and 3D indicators for package opening (partial explanation, memory trigger, and complete explanation). Both full and partial explanations include complete opening information, including hand positions, actions, instructions, and confirmation of the success of the packaging. The only evidence of memory triggers are hand positions, actions, and commands. Full explanation and memory trigger indicators convey all available information, whereas partial explanation indicators only partially achieve this.

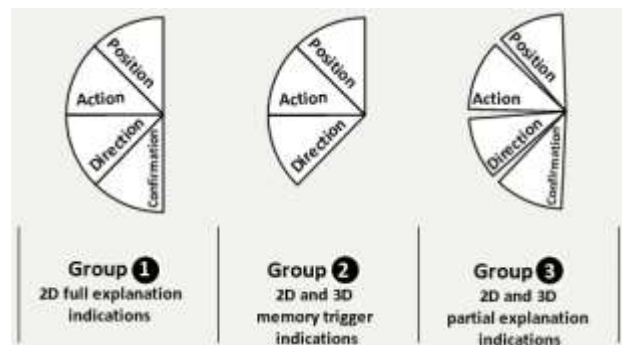The two stages of opening are depicted by repeating semi-circles and distinct hues.

Figure 7. The pattern presenting the use of 2D and 3D indications.

The successful and unsuccessful applications of the information and indications for opening the examined package samples were documented using this visual aid. Conclusions about successful usage of indications and information were made possible by comparing the patterns from successful examples and determining how similar they were. Similarly, inferences about failed usage of information and signals might be made.

5.1 Design Suggestions for Combining 2D and 3D

With an emphasis on the usage of 2D and 3D indicators, the research sought to provide design guidelines for packaging design. Regardless of their visual or perceptual difficulties, most participants opened package samples using both sorts of signals.

Three categories of indicators—partial explanation, memory trigger, and complete explanation—were employed. Older users were also given full or partial explanation indicators to verify that the packaging had been opened successfully. Hand locations, actions, and instructions were shown using complete and partial explanation signs instead of memory trigger signals.

Ambiguous 3D memory trigger signs should be avoided by designers as they might mislead participants. Clear language should be used, and indications should be simple to see, recognise, and comprehend (2D indications). Understanding how to open packaging was also found to be significantly influenced by the stereotyped link between opening techniques and packaging look. In order to provide openable packaging for the elderly, future research should examine how age-related deterioration affects opening ability, especially for those who have arthritis and vision impairments.

6. Conclusion

When creating innovative packaging, it is important to consider age-related needs in sensory, physical, and particularly cognitive capabilities to make sure that older individuals can open the container. A package's design qualities are essentially made up of both 2D and 3D components. However, if the 2D and 3D indications are not developed in tandem to accommodate older people's perceptions and understandings, older people may find it challenging to comprehend how to open packages with both types of indicators. When creating innovative packaging for senior citizens, designers should take into account the design suggestions provided by this study about the usage of combined 2D and 3D indications.

Author Statements:

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