

REVIEW ARTICLE

Research and analysis of user needs for smart clothing for the elderly

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ABSTRACT

Following the principle of “people-oriented”, we explore the user needs of smart clothing for the elderly and provide reference for the development of such clothing. The target consumers of smart clothing for the elderly are divided into two categories: The elderly and the young, and the needs of elderly users are investigated by means of literature analysis and interviews. The study showed that the needs of elderly users for senior smart clothing can be divided into five areas: Physiological, psychological, aesthetic, functional and consumer; the younger group is generally willing to buy senior smart clothing for the elderly and wants functional design to focus on physiological monitoring technology and aesthetic design to focus on loose fit design and dark shades of colour matching. The findings of the study will help companies to improve their design solutions and promote the healthy development of the senior clothing market.

Keywords: smart clothing for the elderly; demand analysis; consumer willingness; research methods

1. Introduction

China refers to people over 60 years of age as elderly people. According to statistics, at the end of 2019, China’s elderly population had reached 254 million, accounting for 18.1% of the total population, far exceeding the standard value for judging the ageing of the population (10% of the total population aged 60 or above), and therefore, the Fifth Plenary Session of the 19th Party Central Committee for the first time elevated actively coping with the ageing of the population to a national strategy^[1]. The elderly in this new era have undergone new changes: Such as longer life expectancy, better

health, more income, greater ability, higher psychological expectations and richer needs^[2], and are an important part of China’s mega consumption potential^[3]. The Guidance on Promoting the Development of the Elderly Products Industry states that by 2025, the overall scale of the elderly products industry will exceed 5 trillion yuan, and that the elderly clothing, which is the first of “clothing, food, housing and transport”, is bound to occupy a larger market share.

However, the existing elderly clothing has fewer varieties and specifications, outdated styles, low fabric, lack of design and comfort^[4], ignoring the actual needs and consumption characteristics of

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the elderly groups^[5], making the supply and update of the elderly clothing market more lagging behind^[6]. In particular, the smart clothing for the elderly, which is still in its infancy, still has many problems, although it gives the clothing intelligent functions to prevent potential risk factors in life from causing harm to the health of the elderly^[7]. In addition, more and more young people, out of filial piety, will help their elderly family members to buy high-quality and high-priced medium-and high-end clothing^[6], and the phenomenon of “buy and use” consumption has emerged, so as one of the target consumer groups, the children of the elderly, their demand for smart clothing for the elderly also deserves attention. Therefore, this study will analyse the real needs of elderly smart clothing consumers and make reasonable research and development suggestions to promote the healthy development of the elderly clothing market in China.

2. Overview of smart clothing for seniors

Smart clothing for the elderly refers to clothing designed specifically for the elderly group, under the condition of ensuring wearing comfort^[8], solving the inconvenience of the elderly in their daily lives^[9], sensing and responding to changes in the external environment and internal state in real time^[10], and realizing the information interaction between the elderly, the clothing system and the mobile terminal, generally applying advanced textile and electronic information technology, and embedding miniature wearable electronic devices into the clothing to achieve this^[11].

Scholars at home and abroad have rich research results on the two major directions of senior clothing and smart clothing, however, there is a considerable lack of research on smart clothing specifically for senior groups. In recent years, with the development of smart wearable technology, some design prototypes have started to appear in the field of smart clothing for the elderly, such as monitoring clothing for the elderly living alone^[12], smart clothing for the elderly against wandering^[13], and

sleep monitoring clothing for the elderly^[14]. However, most of these achievements remain in the laboratory research stage, and it is difficult to promote them on a large scale. The fundamental reason is that they fail to balance the technical and design aspects^[11], resulting in the final results failing to meet the practical needs of the target group, and it is difficult to stimulate consumers' desire to buy.

3. Analysis of the needs of elderly users

As a new product combining traditional senior clothing and smart wearable devices, smart clothing for seniors is difficult to develop, as it has to meet the wearability of everyday clothing while achieving the usability and safety of the target functions. In order to avoid useless development, it is necessary to first find out where the needs of elderly users lie in order to design well and create value. This paper uses literature analysis and interviews with four local elderly people in Suzhou to understand the physiological needs, functional needs, aesthetic needs, psychological needs and consumer needs of elderly users of smart clothing.

3.1. Physiological needs

Due to changes in body shape, most elderly people experience varying degrees of hunch-backedness, a significant increase in back waist knot length and a significant shortening of front waist knot length^[15], as well as an imbalance in the waist-to-hip ratio, making it easy to form a convex abdominal body and hip convex body^[16], making it difficult for the elderly to buy clothes that fit well and restricting their daily activities. Therefore, when designing garment construction, the regular size should not be used only as a design reference, and a revised fit can be achieved by increasing the amount of slack in specific body parts and using elastic fabrics. In addition, the elderly in the interviews indicated that they would prefer natural fibre fabrics because in their consciousness chemical fibre fabrics are not breathable enough and are not good for the skin, so when new fabrics are used in

smart clothing for the elderly, they may be accepted by the elderly as long as they are moisture absorbing and breathable and the electronic components integrated into the fabric do not produce an obvious foreign body feeling^[17].

3.2. Functional needs

Functional needs refer to the requirement for smart services beyond the traditional function of keeping the body warm and sheltered. Compared to acute diseases, the health of older people is more vulnerable to chronic non-communicable diseases such as hypertension, diabetes and cardiovascular diseases^[18], most of which can be monitored and prevented by wearable devices. Smart clothing can embed more sensors to achieve accurate positioning, extensive monitoring of daily activities, and timely collection of physiological signals for older people as it has more contact with the human body than other wearable devices^[19]. Older people in the interviews expressed a willingness to try out health monitoring-type functions, especially finding the fall warning function valuable for promptly notifying family members or medical personnel, but also noted that they would be concerned about the occurrence of inaccurate test results and unsafe circuitry. Therefore, while implementing the pre-defined functions, smart clothing for the elderly should also focus on the accuracy of the test results as well as the safety and reliability of the system.

3.3. Aesthetic needs

Meeting the aesthetic needs of elderly users is crucial for elderly smart clothing, as the beauty of the garment can attract consumers' attention and make it easier for the elderly to accept smart clothing^[20]. Although the elderly group pays less attention to fashion trends in clothing, it does not mean that there is no pursuit of beauty^[21], and their needs for clothing aesthetics include the colour, style and pattern design of clothing. Older people interviewed said they did not like bright colours, preferred neutral colours, tended to favour casual and loose styles, and would be attracted to pattern designs that in-

corporated traditional elements. Therefore, in the process of using e-textile technology, the aesthetics of the garment should also be taken into account, through the use of conductive yarn blends, embroidery and weaving^[22], so that the electronics are integrated into the garment, rather than the simple embedded combinations that currently exist.

3.4. Psychological needs

When faced with negative events such as an empty nest, the death of a spouse, or illness, older people can gradually change from being the independent, self-reliant, caring party to the cared-for party who needs to be accompanied and given care^[4]. In reality, however, most older people are reluctant to rely on their children out of excessive self-esteem and a reluctance to be in a vulnerable position. The functions of smart clothing for the elderly, such as reminding medication and fall protection, can help the elderly to take care of themselves and meet their self-esteem needs. At the same time, the terminal of the smart clothing for the elderly can also be connected to the smart phones of the children of the elderly, so that the children can understand the health status of the elderly through the interactive interface and give them timely emotional care. Therefore, the application interface design of the smart clothing system for the elderly can be divided into two categories: For the elderly, the interactive interface should focus on simplicity and high visibility to minimise cognitive barriers; for the children, the user interface should facilitate the exchange of health monitoring information and give timely reminders and suggestions.

3.5. Consumer demand

The consumption level of the elderly in the new era is not low, the consumption concept is young, for the fashionable new products often with a review component, consumption is more rational, due to the usual exposure to a single information channel, they are more willing to experience in person than advertising and other publicity^[23]. Although older people have a lower level of education,

their enthusiasm for the pursuit of new things is undiminished^[24]. After learning about smart clothing for the elderly, the interviewees said they were willing to try the products as long as they were good enough. In addition, when it comes to clothing consumption, older people attach great importance to offline service experience and have low trust in advertisements, especially for smart clothing, and only when older users can actually feel the beneficial effects of the product will they be inclined to buy it.

4. Analysis of the needs of young people

Consumer behaviour suggests that the decision maker, purchaser and user of a product can be different people. In addition to the elderly themselves, the children and relatives of the elderly will account for a large proportion of the purchasers of smart clothing for the elderly. This paper uses a random sampling method to distribute a web-based questionnaire to young people with older people in their homes. The questionnaire is divided into four sections: Basic information about older people in their homes, consumption behaviour of existing older people's clothing, preferences for design factors of older people's smart clothing, and knowledge of and willingness to consume older people's smart clothing. When investigating the younger group's satisfaction with existing senior clothing, a four-point scale was used, with scores from 1 to 4 corresponding to "dissatisfied", "average", "more satisfied" and "very satisfied" respectively. "The higher the score, the higher the satisfaction level. A total of 224 questionnaires were returned, of which 220 were valid, with an effective rate of 98.2%.

4.1. Basic information for older people in young group homes

The results of the study show that the age of older people in the younger households is mainly between 66 and 80 years old, accounting for 67.27% of the total number of older people. The majority of older people live with their children or

partners, but 13.64% of older people live alone. In modern society, older people have more and more leisure activities, with the most popular form of leisure being walking, accounting for 89.09% of the total.

4.2. Analysis of consumer behaviour of existing senior clothing

As their standard of living improves, young people often help their elderly family members to buy clothes as a sign of filial piety. The frequency and satisfaction ratings of the younger group in helping the elderly buy clothing are shown in **Table 1**. More than half of those surveyed would help the elderly buy clothing one to two times a year, and even 26.62% of the younger group said they would buy more than two times a year. This shows that the younger group is a major consumer group in the senior clothing market that should not be taken lightly. Understanding their purchasing experience and consumption behaviour towards existing senior clothing can provide a valuable reference for the future senior smart clothing consumer market. As satisfaction ratings are mainly concentrated in the 2-point scale, i.e. "average", it is clear that young consumers are not quite satisfied with the current senior clothing market.

Table 1. Frequency and satisfaction of younger age groups in helping older people to buy clothing

Purchase frequency	Number of people/person	Ratio/%	Satisfaction rating/score
More than 2 years 1 time	28	12.73	2.14
1 to 2 times/year	133	60.45	2.03
3 to 5 times/year	42	19.09	2.05
More than 5 times/year	17	7.73	2.41

The price point and satisfaction of the younger group in helping the elderly purchase clothing is shown in **Table 2**. 39.55% would choose clothing priced between \$200 and \$500, which shows that the younger group has better spending power and is willing to spend money on mid to high end clothing for the elderly. Analysing the data from this re-

search, 89.55% of the younger group said that the first factor in deciding to buy clothes for the elderly was comfort level, and that cheap prices did not drive them to spend. In terms of satisfaction scores, it is not the case that the higher the price of the garment, the more satisfying it is, suggesting that the mid-end to high-end senior clothing on the market is not well received by younger consumers and that there is room for improvement.

Table 2. Price points and satisfaction of younger groups helping older people to buy clothing

Clothing price point/\$	Number of people/person	Ratio/%	Satisfaction rating/score
<100	33	15.00	2.00
100–200	83	37.73	2.16
200–500	87	39.55	2.05
≥500	17	7.73	2.00

4.3. Design factor preferences for smart clothing for older people

Functional design preferences for smart clothing for the elderly

It is understood that 54.55% of the younger group said that the elderly in their family had experienced falls, more than half of them said that the elderly had common chronic diseases such as high blood pressure, and about 75% of the younger group surveyed would express concern about the decline in the physical functions of the elderly. Therefore, smart clothing for the elderly with special features can not only help the elderly to age healthily, but also relieve the pressure of caring for the elderly from younger groups. As shown in **Figure 1**, when it comes to the functional design of smart clothing for the elderly, the younger group is most interested in real-time monitoring of physiological indicators such as blood pressure, blood sugar and heart rate, as well as early warning of falls and wandering that can often occur in the elderly, while not being too interested in the function of recording exercise. It can be seen that when designing the functions of smart clothing for the elderly, the immediate needs of the users should be identified to avoid homogenisation of design, and

only really good functional design can impress young consumers.

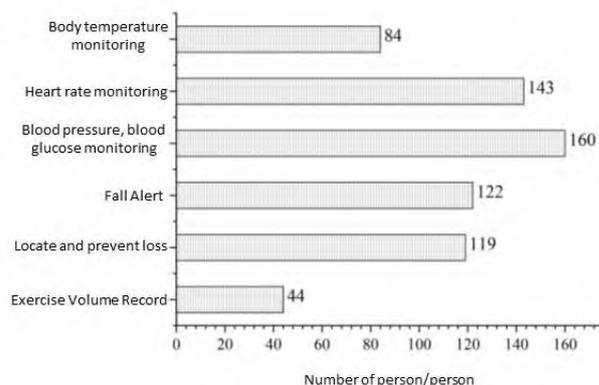


Figure 1. Functional design preferences for smart clothing for the elderly.

Aesthetic design preferences for smart clothing for the elderly

When helping older people to choose clothes, the younger group generally thought that how good the clothes looked depended on how well the fit was designed and how well the colours matched. As shown in **Figure 2**, 58.18% and 40% of the younger group thought that the fit of smart clothing for the elderly should be loose and fitted respectively, which shows that the younger group noticed the changes in the body shape of the elderly and their preference for the fit of clothing is basically the same as that of the elderly. Smart clothing for the elderly is used in their daily lives and has a casual, sporty style, so a loose fit, such as an H-shape, would be more appropriate.

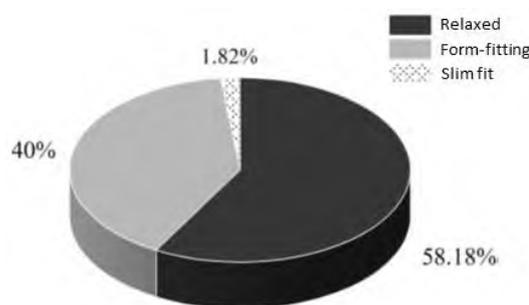


Figure 2. Percentage of pattern design preferences for smart clothing for older people.

As shown in **Figure 3**, 39.55% of the respondents thought that the colour scheme of smart clothing for the elderly was darker and more in line

with what the general public would like, while 24.09% of the younger group thought that the colours of the clothing could be in brighter shades, indicating that young people want the elderly to try new colour schemes and break the stereotypes. This requires designers of smart clothing for seniors to cater to the aesthetic habits of the general public, while at the same time adding a sense of modernity and technology to the clothing through a small range of bold colour schemes to bring seniors closer to their children.

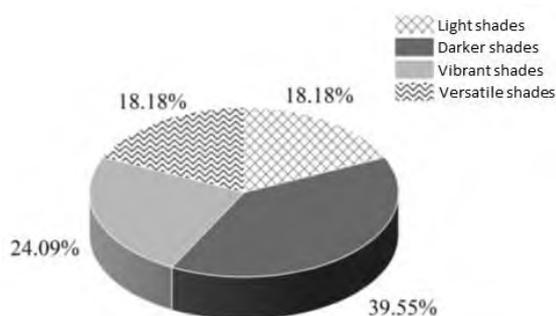


Figure 3. Percentage of colour design preferences for smart clothing for older people.

4.4. Analysis of knowledge and willingness to consume.

The level of understanding of smart clothing for the elderly among young people is shown in Figure 4. 57.73% of young consumers said they did not know about smart clothing for the elderly, and most of those who did know about it were still at the stage of having heard about it. This shows that smart clothing is still in the development stage and has not yet been industrialised, so its presence in the clothing consumer market is very low, inferior to other wearable devices, such as smart bracelets and smart watches.

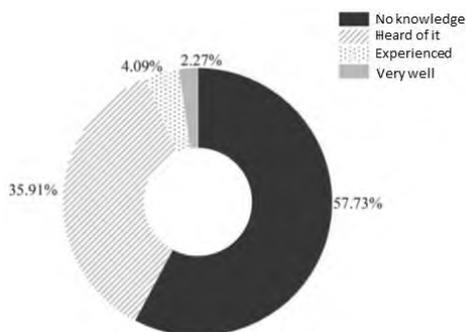


Figure 4. Percentage of people in younger age groups who are

aware of the extent of smart clothing for older people.

According to the research data, it can be seen that the younger group’s knowledge of senior smart clothing will have an impact on their willingness to consume. As shown in Figure 5, the proportion of younger groups willing to buy senior smart clothing does not become larger as their knowledge deepens, but rather young people who have heard of senior smart clothing will be more willing to buy it. This suggests that although young consumers’ knowledge of smart clothing remains at a superficial level, their curiosity about new things will drive them to try new products. On the contrary, consumers who have had in-depth knowledge may have already used wearable products that are not yet mature in the current market and will be less willing to spend on smart clothing for the elderly as many aspects of them are not perfect and leave consumers with a bad user experience.

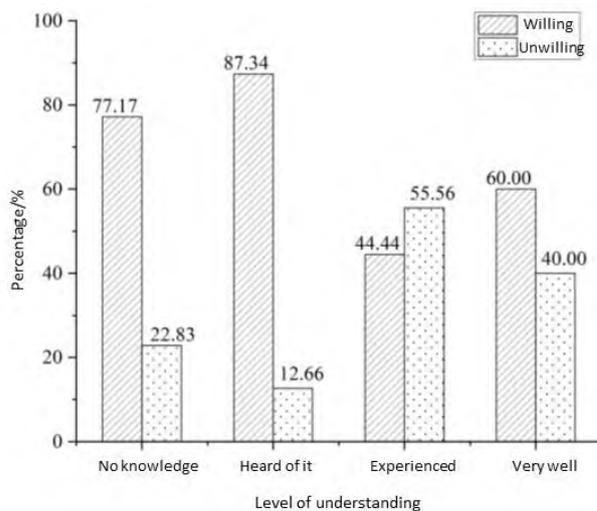


Figure 5. Comparison of the willingness to spend on smart clothing for older people among younger groups with different levels of understanding.

In this research, more than half of the survey respondents said they were willing to buy or use smart clothing for the elderly, with only 46 saying they were not, for the reasons shown in Figure 6, mainly because they were concerned about the inaccurate test results, overpricing and low safety of the clothing. There is a plethora of smart wearable devices on the market, especially in the smart bracelet category, but many users will find that the data from these devices is not accurate and

does not give clear recommendations for treatment, and therefore does not provide substantial help to consumers. This may lead to the same concerns of the younger generation about smart clothing for older people, and places a higher demand on developers to develop products that can only be improved in order to allay the concerns of the younger generation and increase consumer willingness to buy.

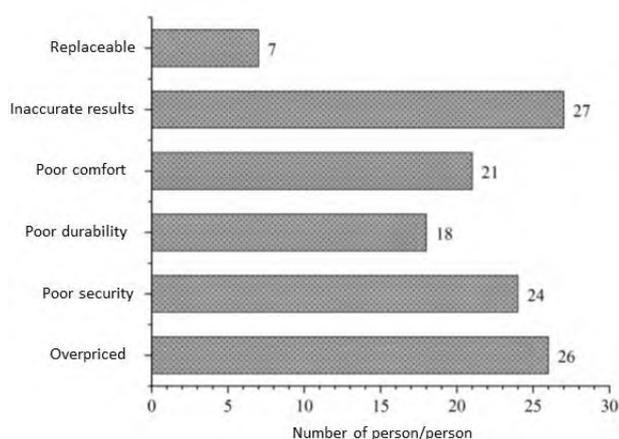


Figure 6. A comparison of the reasons for reluctance to buy smart clothing for older people among the younger age groups.

5. Conclusions

With the continuous advancement of technology, the development of smart clothing for the elderly is a development trend. In order to truly achieve “people-oriented” and demand-driven design, this paper conducts research and analysis on the needs of two major consumer groups. The results of the research show that: The elderly have high requirements for the comfort of clothing and the breathability of fabrics, and are more receptive to smart clothing that can play a safety and protection function and achieve self-care, in addition, smart clothing for the elderly should have a more exquisite appearance design and provide a good fitting experience in order to impress elderly users; most young people will help the elderly in their families to buy clothing, and the price is not low, and they have a basic understanding of the shape and colour design preferences of elderly clothing. Most young people will help their elderly family

members to buy clothes, and the price is not low, and they have a basic understanding of the shape and colour design preferences of elderly clothing, but the elderly clothing currently on the market does not meet their consumption needs well.

Conflict of interest

The authors declare no conflict of interest.

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