Design Studies and Intelligence Engineering
L.C. Jain et al. (Eds.)

doi:10.3233/FAIA231423

Investigating Preference Factors in the Design of Shopping Carts for the Elderly: A Miryoku Engineering Study

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Abstract. By introducing the Miryoku Engineering theory, the mapping relationship between elderly shopping cart design factors and users' perceptual imagery is explored. To design an elderly shopping cart that meets the cognitive preferences of the elderly and promotes social participation. Firstly, we collected and screened the elderly shopping carts in the market, selected representative products as experimental samples, conducted interviews and extracted design factors based on the samples. Secondly, through data analysis, specific design factors were deduced as the reference basis for the design. Finally, combined with the design orientation and analysis, the design factors were introduced to guide the innovative design of the elderly shopping cart.

Keywords. Elderly, Shopping Cart, Miryoku Engineering, Evaluation grid method (EGM), Quantification theory type I

1. Introduction

According to the report of National Bureau of Statistics, the proportion of people aged 60 and above in China reached 18.9%, among which the proportion of people aged 65 and above reached 14.2%, further deepening the degree of aging, and the elderly population will enter a period of rapid growth in the next decade [1]. The clothing, food, housing and transportation industries related to the elderly population are attracting much attention.

After the elderly retired from work, shopping has become one of the main activities of the elderly, which is the main means of communication between the elderly and the society [2]. However, as older people grow older, their shopping behavior decreases [3]. To enhance better social integration and communication among Elderly. Thus, the study of aids in their shopping behavior. According to the survey, 83% of elderly people use elderly shopping carts when they go shopping [4]. However, existing shopping carts for the elderly are relatively single in design and do not take into account the sensual psychological needs and cognitive preferences of the elderly.

The research process and method of Miryoku Engineering will focus on the perceptual psychological needs and cognitive preferences of the elderly, which can effectively explore and attract the charm factors of users. Taking the elderly shopping

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cart as the research object, we analyze the sensual cognition of the elderly users towards the elderly shopping cart, discover the charming factors in it, and conduct quantitative analysis. We will establish the connection between cognitive preferences and product design factors to bring users a new shopping experience. The main research methods are the Evaluation grid method and the Quantification theory type I.

2. Literature Review

2.1. Shopping behavior of the elderly

Internationally, Osmud Rahman et al. used in-depth semi-structured interviews to gain insight into how income, cognitive age, physiological changes, and life-changing events affect elderly consumers' shopping behaviors and preferences as a way to understand the changing needs of elderly consumers [5]; Chinese scholars Yuan Shu et al. used a combination of questionnaire and interview methods, observation and behavior map methods to study the Shanghai elderly [3]. Although the elderly population is only a part of the shoppers, supermarkets are an indispensable public place in the lives of all elderly people who can walk on their own.

2.2. Elderly Shopping Cart

The elderly shopping cart originated in the United States and evolved from the supermarket shopping cart. Cao, Lixiao, et al. have studied the frequency of shopping among the elderly, and found that it occurs on average 5.2 times a week, close to once a day, and has become an important part of the life of the elderly [6]. Yu, Dongjiu et al. also concluded from a survey that shopping carts for the elderly are another high-frequency life support tool in the shopping behavior of the elderly [4].

2.3. Market Status

Yang Simeng et al. pointed out that for the existing shopping carts for the elderly, there are too few types, small choices easy to be taken wrong, etc. [7]; Yang et al. used questionnaire survey method to analyze the needs of the elderly and used fuzzy comprehensive evaluation method to verify the feasibility of the elderly shopping cart design scheme [8]. However, more analysis was conducted from the behavioral experience and functional level. Wang Tiedong et al. pointed out that the emotional needs are the "first needs" of the elderly [9].

2.4. Quantification theory type I

Miryoku Engineering is a research method that captures and organizes individual cognitive concepts with the aim of "creating techniques and learning for charismatic products and spaces", which was initiated by Japanese scholar Masato Ujikawa in 1991. It is a design concept developed by consumer preference, which provides a communication interface between designers and consumers.

The Evaluation grid method is a modified version of the individual construct method proposed by Japanese scholar Junichiro Sanai, which helps to gain insight into the psychological perception of a subject [10].

Quantification theory type I is a is a type of quantitative theory that specifically studies the relationship between a set of qualitative variables independent variables X and a set of quantitative variables dependent variables Y, and uses multiple regression analysis to build a mathematical model between them to achieve the prediction of the dependent variable Y [11].

This study used the median charisma factor of elderly shopping carts as items and the specific charisma form characteristics under each median charisma factor as classes. Suppose there are m items in s samples, denoted as P_1, P_2, ..., P_m, where the gth item P_g has n classes, then δi(g,k) (g = 1,2,...,8; k = 1,2,...,n) refers to the kth class of the gth item in the i-th sample in the i-th sample. Then.

$$\delta_i(g,k) = \begin{cases} 1 \text{ (When the } g \text{ item in the i sample is the } k \text{ class)} \\ 0 \text{ (other)} \end{cases} \tag{1}$$

$$x = \left\{\delta_i(g,k)\right\}, (i = 1,2,\ldots,s) \tag{2}$$

Assuming a linear relationship between the perceptual evaluation value and the factors of the median item and the lower item styling design, a mathematical model can be developed as follows.

$$Y_i = \sum_{g=1}^{M}\sum_{k=1}^{n}\delta_i(g,k)b_{gk} + \varepsilon_I \tag{3}$$

In Eq. (3), Yi is the perceptual imagery evaluation value of the dependent variable y in the i sample; b_{gk} is the kth class constant that depends only on the g item; εi is the random error of the i sampling.

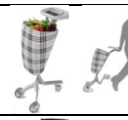
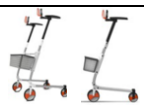
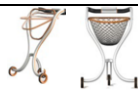
3. Research Process

3.1. Sample Preparation Phase

Firstly, defining the sample: The definition of the elderly shopping cart described in the study from the perspective of structure and function is; structurally the basic components contain wheels, body, and shopping bags; functionally, the sample must contain the storage function in the shopping behavior.

Secondly, sample collection and determination: The sample pictures of elderly shopping carts were collected as comprehensively as possible. After excluding the images of products with poor resolution and difficult to identify their functions. 30 sample images were finally selected as shown in Table I. In addition, the visual angles of the elderly shopping carts in the sample pictures were adjusted to the same level as far as possible, so as to improve the accuracy of the experimental results.

Table 1. Experimental samples

No	Sample	No	Sample	No	Sample	No	Sample
1		2		3		4	
5		6		7		8	
9		10		11		12	
13		14		15		16	
17		18		19		20	
21		22		23		24	
25		26		27		28	
29		30					

3.2. Identification of subjects

In order to fully understand the users' preferences for elderly shopping carts, 11 subjects were invited and divided into two groups: a user group and an expert group, the main purpose of the experiment was to extract the user's preference characteristics based on the user's perspective, so that the charm factor obtained could be more targeted and accurate.

3.3. EGM Interview Implementation

The expert group and the user group were invited to conduct one-on-one in-depth interviews, and the experimental sample cards were all disrupted before the start of each interview, and the interview steps were explained to the interviewees in detail. After obtaining the consent of the user group, shorthand plus audio recording was used to record the whole experimental process. Finally, the KJ method was applied to simplify the data derived from the in-depth interviews with the respondents.

3.4. Questionnaire

A questionnaire was created around this charm vocabulary, a seven-point Likert scale was used to rate the sample pool, and the arithmetic mean of each elderly shopping cart sample under this charm imagery vocabulary was derived.

4. Extraction of design factors

4.1. Results of EGM interviews

After counting and integrating the experimental information from the expert group and the user group in order to draw the elderly shopping cart evaluation constructs, the established elderly shopping cart evaluation constructs are shown in Figure 1.

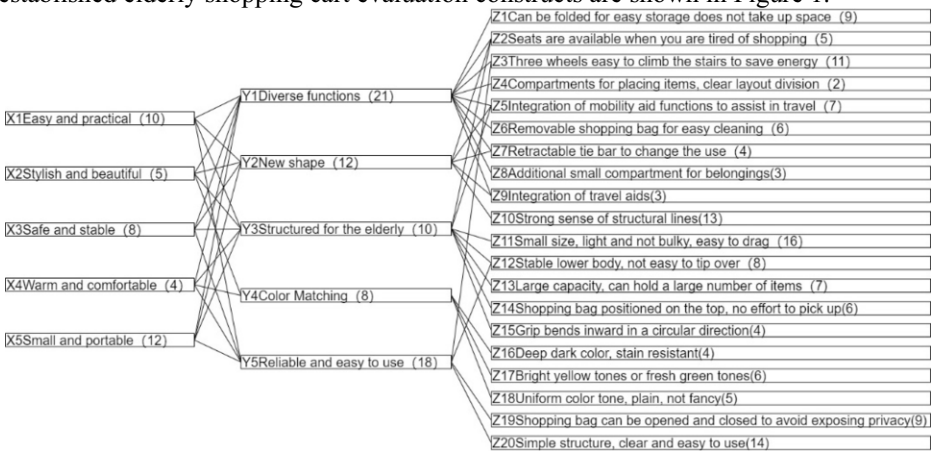


Figure 1. Elderly shopping cart evaluation construction diagram.

4.2. Discussion of results

The Quantification theory type I calculation method can be used to obtain the class score, which represents the conversion score of each class, with negative and positive class scores, where a negative number indicates that each class is negatively correlated to the overall, and vice versa.

Finally, the charm factor evaluation matrix and perceptual evaluation values were input using the formula of quantitative category I. Due to the spatial constraints, selecting the top ranked perceptual imagery for presentation. The results of the analysis are shown in Table II for the example of "easy and practical.

Table 2. Results of the "easy and practical" attractiveness factors

Item	Category	Category score	Partial correlation coefficient	Rank
Y1	Z1	0.2673843	*0.68520	1
	Z2	*0.9203855		
	Z3	0.8740988		
	Z4	-0.1953324		
	Z5	-0.3933564		

	Z6	0.5690543		
	Z7	-0.502579		
	Z8	-2.311995		
	Z9	-1.42582		
Y2	Z2	0.05332797	0.26432	4
	Z5	-0.3817025		
	Z7	*1.407693		
	Z9	1.058485		
	Z10	-2.942263		
Y3	Z2	-0.8191635	0.47853	3
	Z5	*0.6538932		
	Z11	0.1686758		
	Z12	0.2255301		
	Z13	-0.1730571		
	Z14	0.2625048		
	Z15	-0.7121359		
Y5	Z3	-1.579481	0.51481	2
	Z12	0.1263211		
	Z19	-0.8717755		
	Z20	*2.253765		
Constant	2.307542			
R= =0.76480				
R2=0.58492				

(*: Maximum value)

When analyzing the data, it is found that X1>X3>X5>X2>X4, it can be concluded that older users are more inclined to X1 product type and Y1 bias correlation coefficient is greater, among which, Z2 has a higher positive correlation coefficient and greater influence weight. In addition, older users also attach great importance to X3 product type, and the difference between its complex correlation coefficient and X1 is smaller. And, when designing a product, if you want to get a certain product with an imagery style tendency, you should focus on the specific matters (lower items) with positive category scores. Except for the items with high significance, the charm factors with negative scores should be avoided in the design, so as to provide a design reference basis for design practice.

5. Design Practice

By calculating and analyzing using the Quantification theory type I, we extracted the charm factors that are more related to the imagery semantics and have the highest user recognition. In this way, the elderly shopping cart is effectively positioned and designed in a user-oriented way. Putting this design factors into the specific design will have a significant effect on the attractiveness of the elderly shopping cart.

5.1. Design Positioning

Combined with the above data analysis results, under the intention of meeting most users' demand preferences for elderly shopping cart, we segmented the design target group characteristics and drew a user journey map to explore the design requirements and pain points, and then designed the elderly shopping cart. The design analysis of the elderly shopping cart is detailed in Table III.

Table 3. Design target group and scene segmentation

Target group	Crowd characteristics segmentation	Scene segmentation
Elderly who has shopping habits and bring their own shopping tools	1. Vigorous new elderly	1.Taking care of children
	2. Poor physical strength, easily tired	2.Tired of walking without a place to sit
	3. Can't see well	3.Raining on the way
	4. Hard to hear	4.Going up and down stairs
	5. Poor memory, easy to forget things	5.Bending down to pick up things
	6. Joint and back pain	6.Crowded, difficult to pass
	7. Poor balance, unstable walking	7. Buying eggs and other fragile goods
	8. Left-behind elderly, pet companion	8. Going home for storage
		9. Caring for pets

For the design target group positioning, draw its user journey map to explore the design needs and pain points, the user journey map is shown in Figure 2.

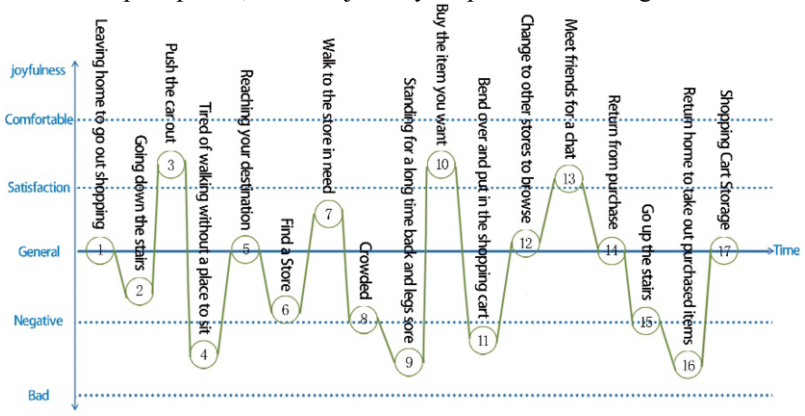


Figure 2. User Journey Map.

For elderly people with poor physical strength and balance, the journey to the grocery store is difficult and they need walking aids, and they usually get tired easily and have no place to rest. After the shopping behavior is completed, it is inconvenient for the elderly to bend down to retrieve things at home, and the storage space of the final shopping cart is also a design requirement for the elderly.

5.2. Charisma factor application

Through the results of the design analysis were summarized, and the overall demand preference was "easy and practical", which was expressed through the variety of functions that could provide seats when tired of shopping. Based on this, "safe and stable" elderly shopping cart also has a greater influence, which is expressed through its small size, lightweight and not bulky; easy to drag and easy to pick up the shopping bag. Creative design for elderly shopping cart with comprehensive design positioning crowd analysis and user journey map pain points mining. Import Rhino software to build the digital model and complete the elderly shopping cart design. The final result is shown in Figure 3.

Figure 3. Final effect.

6. Conclusions

In summary, this paper explores the numerical relationships between the abstract semantic and figurative feature levels of the design factors of elderly shopping carts through the research methods and analytical tools of Miryoku Engineering. A combination of qualitative and quantitative analysis is used and a mathematical model is developed to help designers effectively grasp the design factors that appeal to user preferences in their designs, thus guiding design practice to promote active participation of the elderly in society.

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