

Research on Design Evaluation Method of Walking Stick Based on Continuity Theory

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Abstract. This paper aims to establish an improved innovation design evaluation method based on continuity theory. From the perspective of continuity, we established the mapping relationship between users' demand for walking AIDS for the elderly and continuity, and established the design model of walking AIDS for the elderly with the introduction of continuity theory. Taking the elderly walking stick as an example, the improvement content of the elderly walking stick design and the continuity factors that affect the use intention are obtained from the two aspects of user continuous satisfaction and use intention, and the flexibility and usability criterion should be followed in the improvement and innovation design of the target walking stick.

Keywords. Continuity theory, Walking AIDS for the elderly, design evaluation

1. Introduction

With the accelerated process of population aging, the international community attaches great importance to the coming age of aging. The rapid population growth is accompanied by the prolonged life cycle of people, and the proportion of the elderly in the society continues to increase.[1] This makes the silver hair market full of vitality, and it also brings a new issue of how to improve the well-being of the elderly. In the elderly market, as the proportion of the elderly population continues to increase, the demand for assistive devices has increased sharply. The adaptation and use of assistive devices will be the key measures to solve the society to improve the welfare of the elderly. Among them, walking assistive devices are the middle-aged and senior-aged assistive devices. The category most used by the elderly. From the perspective of traditional user needs, walking aids are not only a tool that can improve personal abilities from a physiological and safety level, but they are also often regarded as a label of "aging and physical frailty". When we re-examine walking aids from a design perspective, adjusting the relationship between the physiological needs of the elderly and social respect has become the key to the design of elderly aids. Therefore, the author believes that starting from the subjective needs of users is an effective solution to this problem. In the survey of traditional design needs, [2] physical needs and psychological needs are often studied separately, but in fact, this is not the case. In the special product type of elderly walking aids, users' psychological needs and physical needs are intermingled with each other, and one cannot lose sight of the other. Humanistic design often uses Maslow as the analysis method of user needs, and this linearly increasing demand will lead to excessive attention to functions and neglect of user psychology. Therefore, this article introduces the continuity theory in sociology as the research guidance for the design needs of the elderly walking aids. The continuity theory is the individual aging theory that maintains the stability of the individual's internal and external structure to adapt to the aging process. Transform the needs

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of the elderly into internal and external continuity requirements that influence each other, analyze the design elements of walking aids for the elderly, and establish a feedback survey model for the design of walking aids for the elderly based on the continuity theory based on the design elements. A survey of continuous satisfaction with elderly walking sticks as an example.

2. Design Concept

2.1. The needs of the elderly based on continuity theory

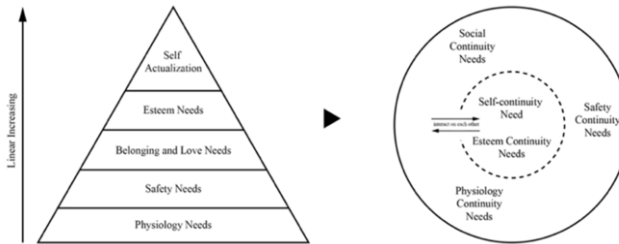


Figure 1. User needs based on continuity theory.

In the design field under the influence of "humanism", Maslow's hierarchy of needs theory [3] is often used to analyze user needs, and human needs are divided into five levels from bottom to top, as shown in the figure (left) from bottom to top. In turn, they are physiological needs, safety needs, belonging and love needs, respect needs, and self-realization needs. Maslow's demand theory is a linear progressive model. High-level needs must be established on the basis of low-level needs being met. This feature provides a basis for our needs analysis and collation, but also leads to the formation of designers' work. It has a linear mindset, and pays too much attention to the bottom-level needs while ignoring the top-level needs.

Based on Maslow's hierarchy of needs theory and combined with continuity theory, the author transforms user needs with the goal of realizing the continuity of the elderly group, and summarizes the continuity demand model of the elderly as shown in the figure (right), which is self-continuous. Sex and self-esteem continuity are internal continuity needs, while physiological continuity, safety continuity, and social activity continuity are external continuity needs. Compared with the linearly increasing structure of Maslow's hierarchy of needs theory, the needs of the elderly based on the continuity theory are centered on internal continuity and have a radial structure from the inside to the outside. Internal continuous demand determines the formation of external continuous demand, and the satisfaction of external continuous demand determines the stability of internal continuity. The maintenance of internal continuity can make people maintain a positive attitude to deal with difficulties. Therefore, the design of the cane product needs to meet the external continuity requirements to indirectly meet the internal continuity requirements, and they are interrelated and interact with each other.

2.2. The design evaluation based on continuity theory

The research on the design evaluation of walking AIDS for the elderly can be divided into comprehensive evaluation and focus evaluation according to the research category and evaluation paradigm. In the design of walking AIDS, comprehensive evaluation is

usually carried out through satisfaction evaluation and psychological attitude evaluation. While focus evaluation is a specific evaluation of a certain aspect of walking AIDS. Focus evaluation has higher flexibility in design and can set goals according to different design objectives. In addition, according to the design evaluation paradigm, evaluation can be divided into subjective evaluation and objective evaluation. The integrated dimensions of design evaluation yield the design evaluation survey type (Figure 2).

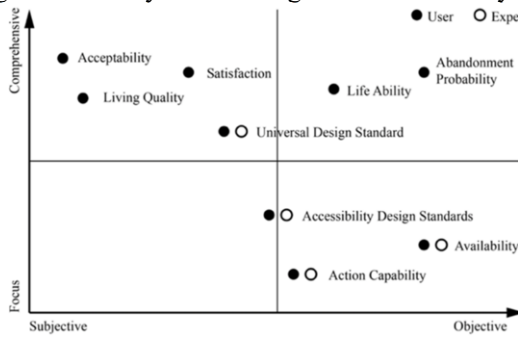


Figure 2. Type of the design evaluation survey.

Assistive devices design process, as shown in the elderly to walk in the design of the existing relevant feedback investigation type of satisfaction, quality of life, acceptance of these three kinds of design feedback for the whole of subjective evaluation, accessibility evaluation, operation ability and availability for assistive devices accessible on foot, the focus of life ability and the availability of the objective evaluation. In the people-oriented design process, the design evaluation process often takes usability as the evaluation standard, among which the most widely used ISO9241/11(International Organization for Standardization) usability survey includes three factors, namely effectiveness, efficiency and satisfaction. [4] In assistive devices applied in the design of walking more is user satisfaction survey, in the design of the existing study on user satisfaction survey is divided into two ways, the first is a user satisfaction survey as the design feasibility, often in the form of questionnaire and interview, content usually set up the user to walk for the appearance of the auxiliary equipment, function, interactive features such as subjective feeling. The second is to collect user feedback in the process of using existing assistive devices as part of the design survey before the conceptual design of assistive devices, and guide the conceptual design of assistive devices.

The indicators of the design evaluation of walking AIDS for the elderly largely determine the direction of the survey results. Therefore, the premise of the establishment of the design evaluation method of walking AIDS for the elderly is the determination of the evaluation indicators. The construction of design elements is often based on the personal experience of designers or experts, but the evaluation of design often needs to be combined with the needs of users. Therefore, the determination of design evaluation indicators in this paper should also be determined in the interweaving of continuous demand elements and design elements.

3. Process and Method

3.1. Design evaluation index

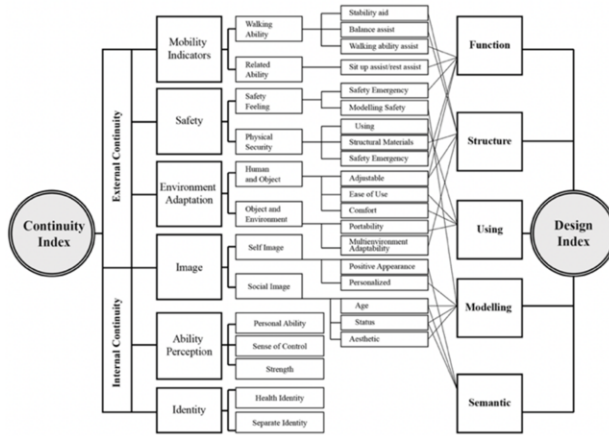


Figure 3. Construct evaluation factor index.

This article takes the cane as an example, analyzes the embodiment of the continuity requirement in the cane design, establishes the continuity between the cane design elements and the continuity requirement, so as to construct the survey scale content for the survey of the use effect of the cane product.

Firstly, one of the effects of the use of the cane is to maintain the external continuity of the elderly, so we need to analyze the relationship between the design elements of the cane and the external continuity from the requirements of external continuity, and construct continuous mobility, continuous safety, continuous environmental adaptation, Requirement index for continuous image of the cane design. Through the user's scoring of these required indicators, it can be concluded that the existing cane products satisfy the user's external continuity requirements.

- **Continuity of mobility indicators**

Continuous mobility is the basic requirement of users for walking aids for the elderly. [5]Physiological changes in the old age cause the lack of mobility of the elderly, and walking aids for the elderly compensate for the mobility of the elderly themselves. Due to the heterogeneity of the elderly, the mobility ability of cane users can be preliminarily divided into walking ability and related mobility ability. The basic effect of using a cane is to improve walking ability, and the user's walking ability is related to walking stability and balance. Therefore, the continuous evaluation of mobility should be comprehensively evaluated from the auxiliary effect of the cane on the elderly's walking ability, mobility stability and balance. Among them, the auxiliary effect of walking ability is related to the functional elements of the cane, which represents the use effect of its basic functions. The auxiliary effect of stability and balance is related to the structural elements of the cane. Its grasping structure and stability structure affect the stability of the cane.

- **Continuity of safety**

The abilities of the elderly in emergency, balance and reaction are far inferior to those of the young, and the decline in physical function greatly increases the risk

index of the elderly in various scenarios. Therefore, the use of walking sticks should be a guarantee for the safety of the elderly, so that the elderly can feel the continuity of safety from the physical and psychological aspects. At the level of physical safety, the design of the cane should mainly consider the safety of the use of the cane, the safety of the structural materials and the safety emergency function of the cane. At the level of psychological perception, the main focus is on the safety emergency function of the cane in dealing with dangerous situations and the safety semantics of the appearance of the cane. The safety semantics of a cane can be expressed through its shape, structure, color and other aspects.

- **Continuity of adaptation to the environment**

The environmental adaptation in the cane design is continuously embodied in two aspects, one is the adaptation between people and things, and the other is the adaptation between things and the environment. In 2014, Dr. Oskar Jonsson [6] and others studied how users of nursing homes in Sweden view the surrounding furniture and found that furniture can enhance personal identity in the eyes of the elderly. Furniture is a product to create the continuity of private space and public space. In 2013, Dr. gowri [7] analyzed the role of establishing self memory box in Alzheimer's facilities from the perspective of continuity, and proposed that self memory box is a tool to cause the elderly to recall, which can help the elderly build self continuity. Therefore, objects are the elements that make up the environment. For the stick user, the stick is the product that has the greatest impact on its adaptability in the environment of its action. The user's adaptation to objects has an important impact on the continuous perception of the environment of the elderly. The adjustability, ease of use and comfort of the cane determine the adaptability of people and objects during the use of the cane. The adaptation of things and the environment is reflected in the applicability of the cane in different use environments, including considerations of portability and applicability.

- **Continuity of image**

The relationship between the cane and the user is not only to provide the user with one-way functional satisfaction, but also to reshape the user during the use process. Whether it is behavior or image, it is the impact of the cane on the user. Image continuity is the continuity of the user's ability to maintain his own image during the use of the cane, including the continuity of personal and social images. The requirement for the continuous design of the personal image of the cane is the positive semantics and individualization of the appearance of the cane, and the continuous social image in the design of the cane is reflected in the consideration of the age, identity and aesthetics of the elderly. Age and identity are the biggest in the social environment. Describing characteristics is like when we describe an elderly person's age as an important indicator.

Secondly, the use effect of the cane is also to meet the continuous needs of the elderly. The internal continuous includes: continuous ability perception and continuous identity.

- **Continuity of ability perception**

The continuity of ability perception is the continuity of the degree of confidence of the elderly in their own abilities, which represents the influence of the use of the cane on the mental structure of the elderly. For users of walking sticks, the perception of self-ability can be evaluated from the continuity scores of the elderly on the three aspects of personal ability, sense of control and sense of strength.

• **Continuity of identity**

Identity continuity is the continuity of the elderly's cognition of self-health and independent identity before and after the use of the cane. Walking sticks, as the first type of walking aids used by the elderly, will have an impact on the cognition of the elderly's own identity. Therefore, by comparing the difference between the health status and the independent status before and after the use of the elderly cane, it is judged whether the status is continuous.

3.2. Experiment Process

The practical process of design evaluation survey based on continuity theory includes two parts: continuity satisfaction survey and comparison evaluation experiment of walking stick. The contents of the investigation practice are carried out sequentially and there is a continuation relationship, as shown in the following table.

Table 1. Design feedback survey content based on continuity theory.

Respondent	Content	Method	Purpose
User	Continuous satisfaction survey of target cane	Statistical survey evaluation	Get user feedback Analyze the improved design content
Target user	Comparative evaluation of canes	Psychophysical evaluation method	Analyze the design elements that influence users' willingness to use

3.2.1. Continuous satisfaction survey of target cane

The object of the continuity satisfaction survey of the target walking stick is the user of the target product. According to the user's experience, the situation that the user meets the requirement of continuity for the design of the target walking stick is investigated, and the improvement point of the design of the target walking stick based on continuity is explored. This research adopts semi-structured questionnaire survey in the form of Likert semantic scale. According to the questions, the respondents choose a group of relative word preference, with the left representing negative attitude and the right representing positive attitude. The score from left to right is 1-5.

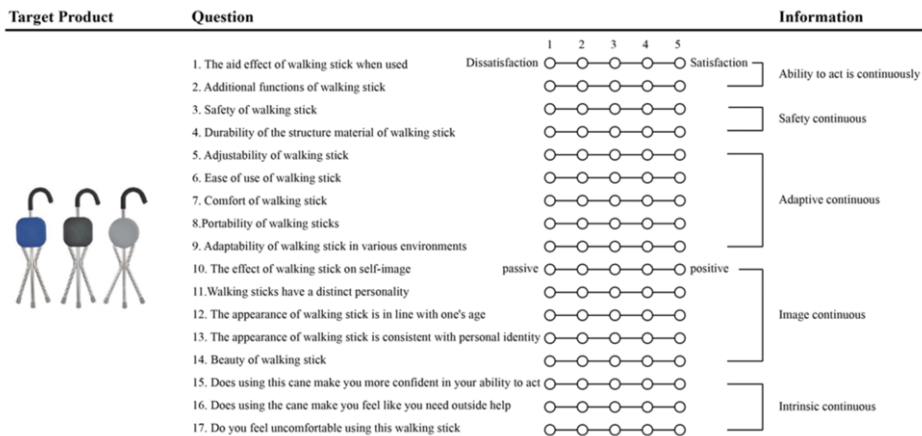


Figure 4. Objective Cane continuity satisfaction questionnaire.

Questionnaire data were collected by field survey and filling in questionnaires, and street survey was conducted by random sampling. SPSS Statistic was selected for statistical analysis in this paper. Firstly, the reliability of the data obtained from the questionnaire survey and the validity of the questionnaire questions were analyzed and verified, and the reliability and validity of the survey data were analyzed. The reliability analysis is divided into external reliability analysis and internal reliability analysis. The external reliability is verified by retest data, and the internal reliability is verified by Cronbach α (Cronbach coefficient). Since the survey is conducted in the form of street interview, it is difficult to contact the survey objects for retest, so the internal reliability is selected to verify the feasibility of the survey results. Secondly, descriptive statistics were carried out for the questionnaire results, including the maximum value, minimum value, average value, standard deviation and median of sample data, etc. The descriptive statistics results can well describe the basic situation of continuous satisfaction of users for this kind of walking sticks.

3.2.2. Comparative evaluation of canes

The evaluation scale of this survey contains three information content, the first content is the basic information of the survey object, age, gender and action ability. The second content is the evaluation of continuity indicators. According to the item items, the evaluation object evaluates the satisfaction tendency of the two samples for continuous mobility, continuous safety, continuous adaptability, and continuous image. The stick X1 is better and the stick X1 is better. , No difference, cane X2 is better, cane X2 is better (scoring from 5-1 points) to choose from five options. The third content is the overall satisfaction evaluation. Because the measurement method of this study is image response measurement, there is no direct contact and experience between the test population and the sample. According to the subjective impression of the image, it is between the cane X1 and the cane X2 Tendency to choose, choose stick X1, stick X1 score 2 points, stick X2 score 1 point.



Walking Stick with chair	Question	Information
 <p>Sample 1</p>	Age/sex/mobility rating _____	Basic information of the elderly
	Which cane helps mobility more _____	Continuity of operational ability
	Which cane looks safer _____	Safety continuity
	Which cane looks more comfortable _____	Adaptive continuity
	Which stick is easier to use _____	
	Which cane is more appropriate in public _____	Index
	Which cane is more adaptable to various scenarios _____	
 <p>Sample 2</p>	Which cane is not awkward to use _____	Image of the continuous
	Which cane looks better _____	
	Which cane is more personal _____	
	Which cane is more identification _____	Using will
	Which cane is more age-appropriate _____	
	Which cane would you prefer to use _____	

Figure 5. Cane contrast content questionnaire.

The investigation is carried out by field research. The main body of the research selected elderly people over 70 years old. Due to perceptual decline and educational level limitations, the proportion of elderly people in this age group who can interpret the design

through pictures and complete the questionnaire independently is relatively small. In the process of field experiments, investigators need to combine pictures first. The way of language explanation is to explain the design elements in the figure in detail to the test seniors, and then ask the seniors one by one according to the question items. The questioning method should be as simple and colloquially as possible. After ensuring that the seniors fully understand the product and the content of the questions, ask the seniors to answer and combine them. Record the old man's answer.

4. Results and discussion

4.1. Continuous satisfaction survey of target cane

Based on the above questionnaire content and survey research methods, a data sample was collected, 31 people were surveyed, and 31 valid questionnaires were obtained, including 18 women and 13 men. And through SPSS software (IBM SPSS Statistics 23.0) for data analysis. In order to facilitate subsequent data analysis, the paper data surveyed are coded and entered into the computer. The following table is the item coding table.

Table 2. Item Code.

Item	Code
The aid effect of walking stick when used	A1
Additional functions of walking sticks	A2
Safety	B1
Stability and durability of structural materials of walking sticks	B2
The adjustability of walking stick	C1
Comfortable use of walking stick	C2
Portability of canes	C3
Satisfaction with the ease of use of canes	C4
Adaptability of canes to various environments	C5
The effect of using this cane on your self-image	D1
This cane satisfies individual personality	D2
The appearance of the cane is appropriate to the person's age	D3
The degree to which the appearance of walking stick conforms to personal identity	D4
The aesthetics of a walking stick	D5
If using this cane makes you feel more confident in your ability to move	E1
If you use this cane, will you mentally feel that you are not healthy	F1
Does using this cane make you feel like a person who needs help	F2

4.1.1. Reliability and validity analysis

Before analyzing the data obtained from the questionnaire, we first need to evaluate the reliability and validity of the questionnaire.

Reliability analysis is used to study the reliability and accuracy of answers to quantitative data (especially attitude scale questions). Reliability is described by analyzing the α coefficient. The α coefficient of this questionnaire survey is ($\alpha=0.882$). When the α coefficient is greater than 0.8 ($\alpha>0.8$), it means this results of the questionnaire are highly reliable.

Table 3. Reliability analysis table(Cronbach Reliability Analysis — Simplified Format).

Number	Sample	Cronbach α
17	31	0.882

Validity analysis is used to study the rationality of the design of quantitative data (especially attitude scale questions), and to judge the validity of the data by analyzing the KMO value. As shown in Table 4, the data validity of this survey is (KMO=0.652, $0.6 < \text{KMO} < 0.7$), indicating that the data validity is acceptable.

Table 4. Validity analysis table (KMO and Bartlett Test).

KMO value		0.652
Bartlett's test	chi-square approximate	247.297
	df	91
	P value	0.000

4.1.2. Descriptive statistics

Table 5. Satisfaction skew data.

Code	AVG \pm Standard Deviation	Variance	IQR	Peak	Skewness	CV
A1	4.129 \pm 1.284	1.649	2.000	0.445	-1.265	31.104%
A2	4.323 \pm 1.013	1.026	2.000	-0.198	-1.126	23.431%
B1	4.194 \pm 1.046	1.095	2.000	-0.941	-0.787	24.949%
B2	4.258 \pm 0.965	0.931	2.000	-0.906	-0.799	22.662%
C1	4.387 \pm 0.919	0.845	1.000	-0.042	-1.158	20.955%
C2	3.903 \pm 1.044	1.090	2.000	-1.508	-0.171	26.752%
C3	3.125 \pm 1.327	1.761	3.000	0.473	-0.014	41.557%
C4	3.806 \pm 1.108	1.228	2.000	-1.601	-0.062	29.112%
C5	3.452 \pm 0.888	0.789	1.000	-0.415	0.766	25.739%
D1	2.323 \pm 1.194	1.426	2.000	-0.378	0.451	51.411%
D2	3.065 \pm 1.263	1.596	1.000	-0.460	-0.023	41.221%
D3	3.290 \pm 1.101	1.213	2.000	-0.507	0.335	33.471%
D4	3.194 \pm 1.138	1.295	2.000	-0.596	0.465	35.629%
D5	3.581 \pm 1.057	1.118	2.000	-1.330	0.407	29.533%

Descriptive statistical analysis should make a statistical description of the data related to all variables of the survey population, including frequency analysis, skewness analysis, and data dispersion analysis. From the skewness data statistics in Table 5, it can be found that C5, D1 The skewness of, D3, D4, D5, and C3 are all significantly greater than zero, which means that there are more data on the right of the mean than on the left. Among these items, the number of people who are dissatisfied is more than the people who are satisfied.

Table 6. Descending table of satisfaction.

Code	Average
D1	2.32
D2	3.06
C3	3.12
D4	3.19
D3	3.29
C5	3.45
D5	3.58
C4	3.81
C2	3.90
A1	4.13

B1	4.19
A2	4.32
C1	4.39

From Table 6, we can find that D1 has the lowest average satisfaction score among the indicators, and its skewness of 0.451 means that this attribute has the lowest comprehensive score in user evaluation. Among them, the lower average satisfaction scores are D2, C3, D4, D3. Combining the skewness, D3, D4, and C3 belong to the low average value and more dissatisfied people than satisfied ones. Taken together, D1 (the effect of using this cane on the image), D3 (appearance of the cane in accordance with the individual's age), D4 (consistent with the identity), and C3 (portability of the cane) are improvements that need attention.

4.1.3. Regression analysis

Table 7. Descending table of satisfaction

Independent variable	Regression coefficient value	Dependent variable
A2	0.264**	E1
D1	0.288**	
D3	-0.163**	
D2	0.139**	F1
D1	0.252**	F2

Respectively, E1 (if using this cane makes you more confident in your ability to move), F1 (if using this cane will make you feel that you are not healthy mentally), F2 (if you use this cane) and F2 (if you use this cane) Does this cane make you feel that you are a person who needs help from others? Perform a stepwise regression analysis. Stepwise regression analysis studies the influence of X (independent variable, usually quantitative data) on Y (dependent variable, quantitative data).[8] A1, A2, B1, B2, C1, C2, C3, C4, C5, D1, D2, D3, D4, D5 are used as independent variables, and E1/F1/F2 are used as dependent variables to perform stepwise regression analysis and calculation, and the specific impact values are shown in Table 7. The regression coefficient value of A2 is 0.264 ($t=4.117$, $p=0.000<0.01$), which means that A2 will have a significant positive influence on E1. The regression coefficient of D1 is 0.288 ($t=4.971$, $p=0.000<0.01$), which means that D1 will have a significant positive influence on E1. The regression coefficient value of D3 is -0.163 ($t=-2.458$, $p=0.021<0.05$), which means that D3 will have a significant negative influence on E1, which shows that the satisfaction of the cane's additional seat function and the effect of the cane on the self. The positive impact of image can positively affect users' self-confidence in their ability to act. The degree of conformity of the cane's appearance has a negative influence on the user's self-confidence in the ability to move. The conclusion of the gradual regression of E1 is that the satisfaction of the additional seat function of the cane and the positive influence of the cane on the self-image can positively affect the self-confidence of the user's ability to act. The regression coefficient value of D2 is 0.139 ($t=2.878$, $p=0.007<0.01$), which means that D2 will have a significant positive influence on F1. Interpreted as the satisfaction of the cane's personality can promote the user to maintain a healthy identity. The regression coefficient value of D1 is 0.252 ($t=4.403$, $p=0.000<0.01$), which means that D1 will have a significant positive influence on F2. This can be interpreted as the positive influence of the cane on self-image will enhance self-efficacy.

4.1.4. Survey Results

For the target product users, they have the lowest satisfaction scores on the four indicators of D1 (the effect of using this cane on the image) and D3 (the appearance of the cane is consistent with the individual's age), D4 (consistent with the identity), and C3 (portability), There are more people who are dissatisfied. The F1 score is the lowest in the user's satisfaction evaluation of the internal continuity index, and D2, which has a positive impact on F1, is also the second-to-last average score, so D2 (personalization) is also an important improvement point. In summary, the target cane needs to be designed and improved for the continuity of the user's image. The main improvements include: reducing the product's negative impact on the user's image, matching the appearance with age, matching the appearance with identity, and improving the portability of the product.

4.2. Comparative evaluation of canes

Through the statistical analysis of the quasi-experimental research, the relationship between the continuity evaluation index and the user's psychological attitude is constructed, and the continuity index that affects the intention of use is obtained, and the continuity satisfaction situation obtained before is analyzed to determine the target walking aid Improve the direction, and analyze the target cane improvement design guidelines to provide guidance for subsequent product improvement and development. In order to facilitate subsequent data analysis, the paper data surveyed are coded and entered into the computer. The following table (Table 8) is a coding table for the item.

Table 8. Item code of comparative evaluation of canes.

Item	Code
Compare the two canes, which one seems to be more helpful for mobility	A
Which walking stick looks safer to use	B
Which walking stick looks more comfortable to use	C1
Which cane is easier to use	C2
Which cane is more suitable for use in public	C3
Which cane is more suitable for various indoor and outdoor use scenarios	C4
Which cane is more portable	C5
Which cane is less awkward to use	D1
Which cane looks more beautiful	D2
Which cane looks more personalized	D3
Which cane is more gender-compliant (looks very feminine or masculine)	F1
Which cane is more suitable for your age	F2
Which cane do you prefer	U

Use A, B, C1, C2, C3, C4, C5, D1, D2, D3, F1, F2 as independent variables, and U as the dependent variable for stepwise regression analysis. After the model is automatically identified, the remaining C2, C5, D2, F2 these 4 items are analyzed. The final specific analysis shows that the regression coefficient of C2 is 0.112 ($t=3.466$, $p=0.001<0.01$), which means that C2 will have a significant positive influence on U. The regression coefficient value of C5 is 0.060 ($t=2.337$, $p=0.023<0.05$), which means that C5 will have a significant positive influence on U. The regression coefficient value of D2 is 0.107 ($t=4.151$, $p=0.000<0.01$), which means that D2 will have a significant positive influence on U. The regression coefficient value of F2 is 0.061 ($t=2.125$,

$p=0.038<0.05$), which means that F2 will have a significant positive influence on U. Therefore, C2, C5, D2, F2 will have a significant positive influence on U.

Table 9. Result of layer by layer regression analysis.

Item	Code	Regression Coefficient	Dependent Variable
Which cane is easier to use	C2	0.112	U(Usage intention)
Which cane looks more beautiful	D2	0.107	
Which cane is more suitable for your age	F2	0.061	
Which cane is more portable	C5	0.060	

According to the above results, the continuity evaluation index that promotes the user's willingness to use is the ease of use, portability, age-compatibility, and aesthetics of the cane in order of impact (Table 9).

4.3. Design evaluation of target cane

Through the continuity satisfaction survey of elderly walking sticks, the contents that can be improved for the target walking stick include: the influence of the target walking stick on the personal image and the age-matching. Through comparative evaluation experiments, it is found that the ease of use, portability, age-matching, and aesthetics of the cane will greatly affect the choice of target users.

Table 10. Results of design evaluation of target cane

Continuous satisfaction survey of target cane (Target cane design improvement requirements)	Reduce the negative impact of walking stick on user image
	Age appropriate
	Befitting
	Portability
Comparative evaluation of cane (Continuity factors that affect users' willingness to use)	Usability
	Portability
	Age appropriate
	Aesthetic measure

From the above results, among the product attributes, the design elements that are not only the needs of the target product to be improved but also the influencing factors of the willingness to use, are "portability" and "age-matching". In summary, the improvement and innovation of the target cane focuses on improving the portability of the cane in terms of function and structure. In terms of form, the color and material combination can be used in the design to weaken the twilight feeling brought by the cane.

5. Conclusion

This paper takes the design of elderly cane as an example to investigate and research the evaluation method of improved innovative product design. The purpose is to obtain user opinions on the basis of existing products and carry out secondary design and development. This needs to consider improving the user's expressed willingness to use the product, and to understand the content with low satisfaction. To optimize these content in the improved design, it is also necessary to pay attention to the attitudes and

needs of the target population. According to the survey results, it is proposed that the flexible and easy-to-use criteria and the appropriateness criteria should be followed when the target cane is designed for improvement and innovation.

- **Flexible ease-of-use criteria**

Elastic ease of use includes the elastic adaptation of the cane between different user sizes, the elastic fault tolerance of the cane in different environments, and the portability of the cane. The ease of use of the cane is based on the size of the cane and the person. Inappropriate cane size is not only uncomfortable and easy to use, but also harmful to the human body. The elastic fault tolerance of the cane in different environments determines the unity of the ease of use experience of the cane. The cane adapts to different environments, and also reduces the risk of the elderly caused by the cane in different environments, and maintains the continuity of the user experience in different environments. The portability of the cane allows the cane to adapt to more places of use, facilitates the switch from use to the idle state, and reduces the impact of the use of the sitting cane on personal daily behavior.

- **Suitability criteria**

The suitability criteria include the suitability of the cane to the user, and the suitability of the cane to the environment. The appropriateness of the cane to the user means that the shape of the cane fits the user's psychological needs, maintains the user's image, and creates a comfortable and cordial experience for the user. The adaptability of the cane to the environment refers to the adaptability of the cane in different environments, including functional adaptability and appearance adaptability. Functional adaptability is reflected in the portability of the cane and the usability of the cane in different environments. Appearance adaptability is the identity of the product and the user Match, will not bring use burden and psychological pressure.

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