User Experience Design Research of New Types of Home Appliances Based on the Analysis of the Learning Curve of the Elderly

Bin Jiang(✉), Lili Tian(✉), and Di Zhou(✉)

School of Design Arts and Media, Nanjing University of Science and Technology, 200 Xiaolingwei Street, Nanjing 210094, Jiangsu, China
jb508@163.com, l091268286@qq.com, zhoudi@njust.edu.cn

Abstract. Based on the learning curve of the elderly, this paper analyzed the user experience design of new types of home appliances. Firstly, it gave an introduction to user experience design and its social meaning. On the basis of the special characteristics of the elderly, the user experience design of the new types of small home appliances will bring great convenience to the elderly. Secondly, this paper analyzed the user experience design of home appliances used by the elderly. At present, due to the problem of excessive functions, complex operation and "younger tendency" of small home appliances in the market, it conducted an analysis of the physical and psychological factors of decreased learning ability of the elderly by making use of these problems. Then this paper illustrated the necessity of the elderly to use user experience design. At last, it put forward the principles of easy operation, easy function, humanization and fault tolerance according to the problems encountered by the elderly when they use new types of home appliances.

Keywords: User experience design · The elderly · Learning ability · New types of small home appliances

1 User Experience Design

1.1 User Experience Design

Based on appropriate appraisals of user's real expectation and purpose, user experience design is a user-oriented research. It revises the design product so as to guarantee a perfect interaction during the communication between people and machines. User experience is the response of the individual after being stimulated by the outside world. Viewing from different angles, it has different division. In his book *Emotional Design*, Norman analyzed levels of human cognition from the perspective of cognitive psychology (Fig. 1). According to him, it could be separated into instinct, behavior and reflection level [1]. The design of the instinct level refers to the external image of the product. At this level, product experience is only the preparation period which focused on the development of external factors like color, form and material in order to

J. Zhou and G. Salvendy (Eds.): ITAP 2017, Part I, LNCS 10297, pp. 233–243, 2017.
DOI: 10.1007/978-3-319-58530-7_17

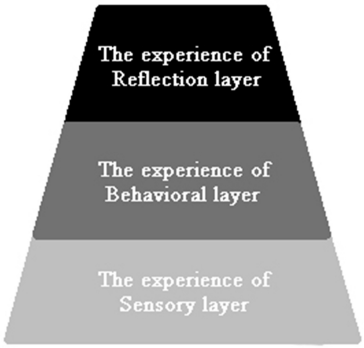

Fig. 1. The levels of user experience

stimulate users favorable initial instincts toward the product. Only at the behavior level will the design relates to the interaction between users and products. After using the product, users will have a more clear understanding of the function, performance and utility of products. During the interaction process, the design of an excellent product from the aspect of behavior level is based on the behavioral characteristics of users. By dong so, it can generate perfect experience from users towards products. The design of the reflection level tries to materialize ideological values and it enters into the feedback period of user experience. Designers try to express values through products' designs so as to meet users' demands and fulfill their aspirations. During all periods of using the product, the ideal user experience degree curve is supposed to be a straight line (Fig. 2). However, present user experience design put much emphasis on the preparation and interaction period which can bring benefits to developers. This initiative has exerted negative influence on the small home appliances used by the elderly, that's to say, the lack of efforts on products' feedback period will render it impossible to solve problems caused by the universal "younger tendency" home appliances presently used by the elderly. This can greatly affect old people's use of small home appliances. As a result, this paper focused on the analysis of special psychology of old people's unwillingness to use small home appliances due to decreased learning ability and gave a conclusion of the principles that old people should follow when using new types of small home appliances (Fig. 3).

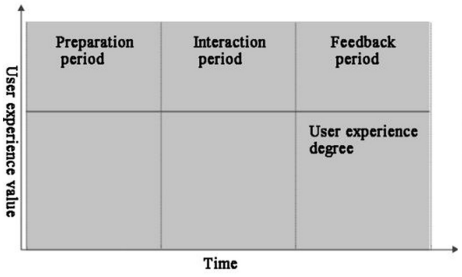

Fig. 2. The levels of user experience

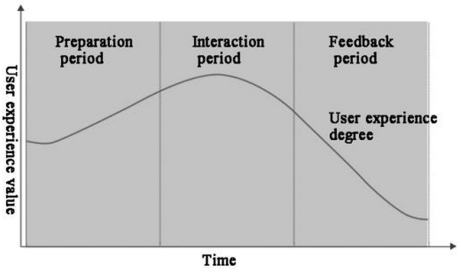

Fig. 3. The levels of user experience

1.2 Social Meaning of User Experience Design

User experience design was developed according to the analysis of users' needs. By analyzing the characteristics of the elderly and designing small home appliances which meets their specific needs, it has the social meaning of bringing convenience to the elderly and making them feel willing to use these products.

2 User Experience Design Analysis of New Types of Small Home Appliances for the Elderly

2.1 Current Problems with Small Home Appliances Design

As a kind of daily necessities which is closely related to human life, the development of current home appliances is tightly combined with high technology. The new types of small home appliances mentioned in the paper mainly refer to those united with high technology. With the improvement of people's living standard, there is more and more demands for small home appliances. However, despite its fast development, there exist some major problems in terms of the design:

(1) Excessive functions. Presently, many manufacturers of small home appliance tend to improve their competitiveness by add more functions to products. Although it can attract lots of consumers, it can also bring the problem of because of complex operation result in inconvenient for use. For example, general microwave oven sold in the market has 80 to 160 kinds of functions. There are 100 to 400 kinds of functions on its menu [2]. The rice cooker was firstly invested to cook rice. But at present, new types of rice cookers (Fig. 4) can make cakes, cook porridge and dumplings. In fact, the elderly don't need so many functions. The repetition of function will only render it more inconvenient for the elderly to use them, not to mention operating them.

(2) Complex operation. The increment in functions results in more and more operation keys and the more complex operation interface. Faced with a wide range of functions and operation keys, the elderly feel at a loss on how to operate them, sometimes they even feel disappointed and annoyed towards these designs.

Fig. 4. New types of rice cooker

Fig. 5. Multifunctional cookware

Fig. 6. Outlet connected with WIFI

Giles Colborne, an English designer, stated in the book *Above Simplicity* that users want to feel that they are controlling the technology they are using now [3]. So in terms of many high-tech products, the elderly only hope that this product can finish a certain task in a more convenient way.

(3) "Younger tendency" [4]. Now the design of small home appliances in the market does not cater to the characters and needs of the elderly. For instance, the continual upgrading of the functions of new types of small home appliances (Fig. 5), the connection of products with WIFI for operation (Fig. 6) and so on all lead to failure in use of the elderly, which even brings "techno-phobia" among them. This tendency results in old people's unwillingness to use these small home appliances.

2.2 Current Problems with Small Home Appliances Design

People's learning ability generally won't decline with the increase of age, but the following factors can affect the learning ability of the elderly and lead to decreased learning ability among them. This paper analyzed it from the physical and psychological aspects:

(1) Physical factors

Physical factors can be viewed from two aspects. On the one hand, the increase in age and decline in memory (Fig. 7) will affect the learning ability of the elderly. Faced with complex functions and computer menu setting of small home appliances, an increasing number of the elderly feel the difficulty in operating and memorizing all the steps. On the other hand, the elderly will face declined physical functions with the increase in age. Physical functions influencing their use of small home appliances include vision, hearing, touch, hand and foot dexterity and brain activity, etc. All these physical factors have weakened old people's perception of and control over small home appliances and

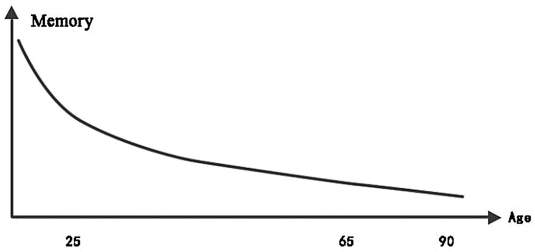

Fig. 7. The change of memory curve with the increase in age

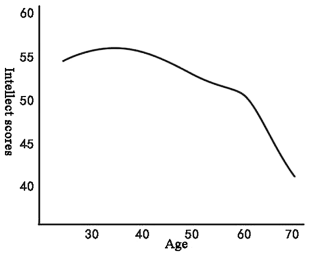

Fig. 8. The change of intelligence curve with the increase in age

thus reduced their efficiency in operating them and increased the probability of incorrect manipulation. The research has found that ole people's average ability of using home appliances is 3.63 [5]. The reason behind that is the decline of old people's intelligence under the influence of physical factors with the increase in age (Fig. 8), but the design of new types of small home appliances gives no specific consideration of the elderly.

(2) Psychological factors

The change of psychological features is bound to exert influence on psychology [6], which also has to be viewed from two aspects. For one thing, the elderly lack motivation for learning and they tend to make analyses by experience. With the increase in age, they become more conservative which reduces their curiosity for new things. For another, the elderly have fewer opportunities for learning and face declined ability for learning new knowledge after retirement. These psychological factors hinder their use of new types of small home appliances so that they even harbor dull and fearful feeling towards these products.

2.3 The Necessity of Highlighting User Experience Design of New Types of Small Home Appliances for the Elderly

Now, user experience design has penetrated into every aspects of our life which has exerted positive influence on our quality of life, lifestyle and society. It's influence on old people's use of small home appliances are stated as follows:

(1) Meeting old people's needs of sensory experience

Sensory level experience means the experience of people's sensory organs stimulated by outside existence. When using small home appliances, the relevant sensory experience include vision, hearing and touch. The form, material, color and finishing process of products will bring stimulation to users' vision and touch. Some of them even have speech control which can bring stimulation to users' hearing. So after the process of designing user experience and understanding old people's special sensory needs, we can design new types of small home appliances that satisfy their sensory experience.

(2) Meeting old people's needs of behavioral experience

Behavioral experience is the one that occurs during the interaction between users and products. When using small home appliances, users make the most frequent interaction with products by their two hands. Foe example, they have to press the button when using rice cooker. Moreover, some of the current smart TVs can be controlled by hand and body gestures. On the basis of understanding problems like inflexible physical activity faced by the elderly when they become older, after user experience design process, we can avoid some complex interactions so as to provide products which are easier to use.

(3) Meeting old people's needs for emotional experience

Emotional experience is a kind of response generated after the interaction between users and products. On the one hand, after user experience design, new types of small home appliances can enable the elderly to have control over products by their good functions, ways of operation and interactions. On the other hand, their design of outer appearance can show great concern for the elderly.

3 Principles of User Experience Design of New Types of Small Home Appliances Based on Decreased Learning Ability of the Elderly

3.1 The Principle of Easy to Use

Easy to use is the most fundamental principle when designing new types of small home appliances. The principle of easy to use for products used by the elderly mainly include easy to learn, easy to memorize and easy to identify. New types of small home appliances based on the principle of easy to use can help users to learn instructions quickly and bring more convenience to them.

(1) Easy to learn

The elderly tend to think in a certain manner and they are very slow in learning new knowledge. They will only recognize things that are familiar to them. New types of small home appliances now sold in the market have too many varieties and functions which are very complex to operate for the elderly. They feel very confused about using these products. As a result, it is very necessary for the products to be easy to operate for the elderly, especially those small home appliances like kitchenware which are indispensable in our daily life. When designing these products, we have to ensure that the elderly can learn and use them directly by referring to their experiences without any specialized instruction. We can realize the principle of easy to learn by reducing products' functions so that the elderly can learn to operate by their experience.

(2) Easy to memorize

With the increase in age, the elderly will face declined memory and even have Alzheimer's disease which can greatly hinder their ability in using small home appliances.

So it is also very necessary to design products which are easy to memorize for the elderly. When design products, we should reduce their memorial burden so that they don't need to relearn instructions after initial learning. We all know that our ability of using products relies on two kinds of knowledge [7]: internal knowledge within our mind (long-term memory) and external knowledge (in the form of suggestions presented by products' design to give right instructions). As a result, we can reduce old people's memorial burden of using small home appliances in two ways. One way is to design products by taking advantage of users' long-term memory (designing products in the way that is easy to operate from ole people's memory); the other is to make proper use of users' short-term memory by applying suggestions like vision, hearing and touch to inform design.

(3) Easy to identify

With the increase in age, the elderly will have difficulty in identifying items like buttons, keys and text because of the decline in their vision, hearing, hand and feet dexterity and mental flexibility. For instance, although new types of home appliances like TV, washing machine and STB have already united with high technology, they still use the traditional remote controls. At this time, it comes to the question of identifying these messages faced by the elderly. Kitchenware is still operated through pressing different kinds of buttons which also relates to the identification problems faced by the elderly. The use of small home appliances is to improve the quality of our life rather than indispensable items. So most users of this kind of products are youngsters, there are few old people using them now. Moreover, these products are often operated by pressing buttons. The only problem remains for the elderly id the identification of different functions of these buttons. So it also turns out that the design of small home appliances should be easy for the elderly to identify them. By conducting surveys on the behaviors of the elderly when they use small home appliances, designers can design products which are able for the elderly to operate by their experience.

3.2 The Principle of Easy to Operate

With the increase in age, the elderly also witness changes in their heights. For instance, they will have problems like hunchback and decline in heights. So the principle of easy to operate can be reflected from the following two aspects. That's to say, the ease of operation in terms of interface and ways.

At present, new types of small home appliances all have interface. The design of interface is also a critical factor influencing users' choice of a particular product. The existing products in the market generally ignore the problems faced by the elderly. For one thing, the interface design of current products doesn't take into consideration the problem that the elderly have to face the decline in heights and sensory functions when identifying prompt tone and indicator light. To cite as an example, some rice cookers (Fig. 9) will automatically turn to heat preservation when the rice is ready. There are prompt tones during the process. However, if the sound is too small, it will be of no use for the elderly who are experiencing declined hearing. So designers have to take declined hearing of the elderly when choosing prompt tones, great attention should be

Fig. 9. Rice cooker

paid to choosing appropriate warning tones. Besides, the choice and layout of products' interface shows no concern for the elderly. For instance, the text on some rice cookers is so small that the elderly are unable to see that because of the decreased vision. That will in turn lead to old people's failure in using products. As a result, designers have to make appropriate choice and arrangements of elements like buttons, keys and text according to the visual features of the elderly when designing products.

The widespread use of new types of small home appliances brings about one problem. That's to say, faced with excessive functions and complex operation, the elderly feel very confused when using them. Say, smart TVs, which are popular now, have added functions like downloading software, watching movies online and playing games. Although more functions can provide more experience for users, the problem is that the remote control will have more buttons (Fig. 10) and the setup of STB (Fig. 11) which renders them more difficult for the elderly to use them. There are even some old people don't watch TV because of the difficulty of setting STB. So firstly, designers have to put aside unnecessary functions and try to improve the core functions by taking old people's needs and liking into consideration. Secondly, the process and ways of

Fig. 10. Remote control

Fig. 11. STB for TV

operation should be as easier as possible. If these products are indeed to be complex, they should be able for the elderly to operate them by simple learning based on experience.

3.3 The Principle of Humanization

Humanized small home appliances are centered on the elderly. During the design process, designers take full consideration of the elderly and making them feel the care and concern when using products. The principle of humanization can be illustrated through three aspects: humanized sensory experience, humanized behavioral experience and humanized emotional experience.

(1) Humanized sensory experience

Humanized appearance of products can express a feeling of concern to users by their visual messages. Humanized sensory experience of new types of small home appliances used by the elderly comes from vision, hearing and touch. In terms of their vision, they generally encounter the problem of declined eyesight. So products with humanized sensory experience have the following advantages. For one thing, designers take into consideration of the visual features of the elderly when choosing visual elements by avoiding the use of bright colors so as to avoid incorrect manipulation of products. For another, designers try to make sure that the text and pictures are bid enough for the elderly to identify. From the perspective of hearing, now nearly all products have prompt and warning tones. Old people's decline of hearing will pose threats to their use of products so products with humanized sensory experience also have the following merits. Firstly, when choosing buttons, designers try to use those which can be identified through touch so as to reduce the probability of incorrect manipulation. Secondly, due to the fact that old people's touch flexibility decreases with the increase of age, products demands little touch flexibility of users. At last, small home appliances used by the elderly have so many buttons that the elderly may have the difficulty in operating them because of their inflexible movements. So designers will try to expand the distance between different buttons without influencing everyone's performance.

(2) Humanized interaction experience

During the process, the elderly will have interactions with products. Only good interaction can encourage the elderly to continue their use of these new types of small home appliances. Because of decreased learning ability of old people, interaction experience of products should give concern to two aspects. Firstly, when choosing ways of interaction, designers should prefer those which are subconscious to the elderly like ways that has already been used in products. Sub consciousness is the fundamental motivation for awareness [8]. For the elderly, subconscious interaction is a kind of motivation. Only when they feel motivated will they be willing to use these products. Secondly, the process of interaction can lead to the operation of the next step. To a certain extent, it can be used to motivate the elderly to use new types of small home appliances and reduce their burden of learning.

(3) Humanized emotional experience

The purpose of products' humanized emotional experience is to create an emotional connection between users and products. According to Norman, emotion belongs to the reflection level of product design. Products with humanized emotional experience should provide users with good experience, convenient interface in order to make users feel happy, pleasant and secure during the whole process.

3.4 The Principle of Fault Tolerance

Fault tolerance is the ability to withstand false performances of products. Fault tolerance design of products can promote the smooth communication between users and products [9]. Fault tolerance mechanism of product design (Fig. 12) can improve the reliability of products. Fault tolerance should definitely be implemented to the design of small home appliances used by the elderly. It can be introduced from two aspects. On the one hand, designers should avoid incorrect manipulation. Certain literature pointed out that meaningful control of elements can reduce users' incorrect use. Fault tolerance of mew types of small home appliances reaches its aim of design control by physical constraints. For example, kitchen home appliances in the picture (Fig. 13) are controlled by rotate buttons. The design of buttons renders it unable to be operated by other means. On the other hand, all the incorrect manipulation that happened can be saved. For instance, the backspace key of the remote control (Fig. 14) just displays this principle.

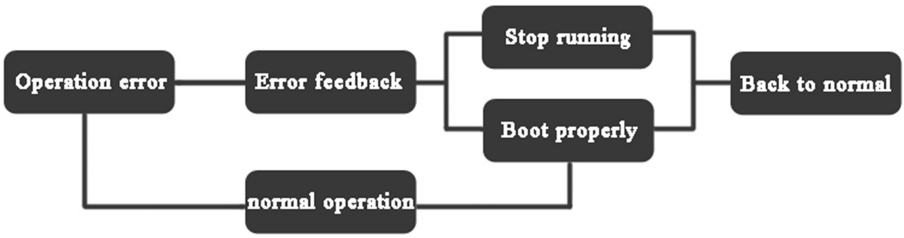

Fig. 12. Fault tolerance mechanisms for product design

Fig. 13. Smart rice cooker

Fig. 14. Remote control

4 Conclusion

The design of new types of small home appliances is for the benefit of human life. However, for the elderly who have "techno-phobia", it fails to bring convenience to them. As a result, when designing these products for the elderly, designers should take into consideration of psychological problems like declined memory and physical activities, lack of motivation and decreased learning opportunities so that the elderly will be more willing to use these products. Only when designers find the reason for old people's reluctance to use new types of small home appliances will they design products favored by the elderly.

References

1. Huang, S.: Application of user experience in APP design. Master's degree thesis, School of Design and Arts, Xi'an University of Science and Technology, Xi'an (2012)
2. Li, M.: Discussion on the interface design of smart small appliances from the user's needs. Acad. Res. **4**, 117–118
3. Colborne, G.: Simplicity First: Interactive Design Four Strategies (Turing Interactive Design from the book), pp. 39–40. People's Posts and Telecommunications Press, Beijing (2016)
4. Degrees [EB/OL]: Baidu Encyclopedia, 2 January 2017. http://www.hbrc.com/rczx/shownews-4014667-19.html
5. Quan, L.U.: Analysis on the demand of household appliances with the weak feature of the old. Packag. Eng. **36**, 81–84 (2014)
6. Xu, H., Xu, Y.: Interacting design of home sphygmomanometer for the elderly. Design (5), 121–122 (2015)
7. Norman, D.: Psychology of Design, pp. 133–172. CITIC Publishing House, Beijing (2010)
8. Huang, H.: On the existence and function of the subconscious. J. Ningbo Inst. Educ. (6), 52–56 (2004)
9. Yan, X., Nie, P.: Fault tolerance thinking in product design. J. Donghua Univ. (Nat. Sci.) (38), 636–639 (2012)