Applying Usability Testing in the Evaluation of Products and Services for Elderly People

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Abstract. A usability testing study on Self-help Health Checker, a human-machine interactive medical service system for the elderly people was introduced in this paper. The goal is to evaluate the product quality and users' experience when the product is at the very early stage of market launch. The test was conducted in the Lab of Psychology and Behavior Testing for the Elderly People, which consists of the Testing Room and the Observation Room. A professional audio-video system was set for recording the whole testing process. Seven subjects of different age and education background were invited to do the test. The methodology of Observation, Think Aloud, and Group Discussion were adopted. The test focused on the system stability and interface friendliness. Test results showed that this target product needs improvement in "degree of self-help" and "elderly user-friendliness" aspects.

Introduction

Usability testing was conducted when the product/service is in the prototype or finished stage. It provides foundations for the enhancement of quality and improvement of design, making it an indispensible step for successful market launch. The increasingly severe aging situation in China has lead to the emergence of various products and services for the elderly people. Like other products, the products and services for elderly people need also the usability testing to discover possible quality defects and poor users' experience before going to the market. Usability testing helps product designers/engineers to evaluate the quality effectively, and make improvements accordingly at the first time. Due to the specificity of elderly users, developers and designers should take special consideration of both their psychical and psychological characteristics in the human-machine product/service design, to make the products/services "elderly user-friendly" in the real sense.

Research Design

Research Background

The product involved in the paper, i.e. the Self-help Health Checker, is a Taiwan-made product based on collaboration project between one Taiwan company and Beijing Research Center of Urban System Engineering. The Self-help Health Checker has five functions in total: Blood pressure measuring, Blood oxygen measuring, Blood sugar measuring, Electrocardiogram measuring, and Weight measuring. Due to the fact that no medical staff attended the testing process, the test of blood oxygen measuring (which needs blood
sampling) was skipped for the safety of the subjects. It has a touch screen and associated devices. For each function, there is an instruction stating how to use it on the screen.

**Research Objective**

To evaluate the quality of Self-help Health Checker, a human-machine interactive system for medical services targeted at the elderly people. In particular, the system, function, interface, devices, and users' experience were tested.

**Research Design**

1) Testing environment (where). The test was conducted in the Lab of Psychology and Behavior Testing for the Elderly People, which consists of the Testing Room and the Observation Room. In the Testing room, the Self-help Health Checker machine product was placed on a square table. Its accessories are also attached. A comfortable chair was prepared for the elderly people to sit on. A tester was also available in the testing room, giving the subject clear descriptions of the testing tasks. Three cameras were set on three corners of the testing room. A microphone was also put on one wall in a natural way. The Observation Room was right next to the Testing Room. The observers could observe the testing process through two means. One is by watching through the one-way mirror installed in the wall that separating the two rooms. The other is through the professional audio-video recording system. A server was put in the observation room and could clearly collecting what happened in the Testing Room, i.e. the video pictures, the elderly people's words, facial expressions and body languages while the testing was conducted.

2) Subjects (who). Seven subjects were invited to do the usability testing. Their demographic feature was described as below: a) One elderly person over 80, with high educational background and strong work experience. b) Two elderly persons over 70, of whom the male person with plenty of managerial experience (in terms of work skills), and the female person without. c) Two elderly persons over 60, two female persons who just retired. d) Two middle-aged persons (between 30-50), one with high educational background and the other received very rudimentary education.

3) Test tasks (what). The subjects were invited to finish testing tasks: a) Log-in the health checking system by inserting one's ID number b) Help oneself to do the blood pressure measuring c) Help oneself to do the blood oxygen measuring d) Help oneself to do the electrocardiogram measuring e) Help oneself to do the weight measuring f) Print the health checking report.

4) Test scenarios (what kind of). The testing scenarios were divided into three types: After giving descriptions of testing tasks, a) For the elderly people over 70 years old, the tester gave both instructions and demonstration about how to finish the whole testing tasks; the tester give necessary hint and help. b) For the elderly people over 60 years old but less than 70 years, the tester gave only instructions about how to use the self-help health checker; the tester stay with the subjects, but try not to give help or hints during the testing process. c) For the elderly people between 30 to 50 years old, the tester just told them they need to finish six tasks and they can refer to the instructions on the screen for help. The tester leave the Testing Room after the subject was clear about the tasks.

5) Test procedures (how to do it). The whole round of usability test lasted for about 1 hour per person, including 5 steps: a) Step 1: The subject was invited to the Preparatory room for rest and preparation. b) Step 2: The subject was guided to the Testing Room. c) Step 3: The Tester gave welcome and introduction of the lab environment to the subject and told the
subject the testing tasks (and gave instructions or demonstrations depending on the test scenarios). d) Step 4: The subject finish all the testing tasks. e) Step 5: The subject was guided outside the Testing Room, and went to the Preparatory room for a survey. After that, the test ended.

Research Methodology

Usability Testing

According to Jeffrey and Dana, "usability testing" is a research tool, it is the process that employs people as testing participants who are representative of the target audience to evaluate the degree to which a product meets specific usability criteria. In this study, we invited 5 elderly people who represented three groups of aged people and 2 middle-aged people as the contrast testing participants to use the self-help health checker, to see whether the system and functions meets their expectations.

Observation

With the help of the one-way mirror, the observation sheet, as well as the video picture and audio sound, the observers carefully observed the whole process of each testing participant to do the self-help health checking, writing down their verbal words, capturing their facial emotions and body languages, and also their related reactions towards the machine.

Think Aloud

Think aloud protocols consist of observing a user working with an interface while encouraging them to "think-aloud"; to say what they are thinking and wondering at each moment. The subjects were asked to say loudly what they think and doubt while performing the tasks, as well as other related thinking thoughts such as how to find buttons on the system screen.

Group Discussion

After each ground of testing finished, the tester and the observers will have a group discussion on the whole process and subjects' performances over the video camera and observation notes. In this way, a general and quick feedback about each testing was collected and documented. After all grounds of testing finished, group discussion was held again, to systematically record the common problems and according solutions concerning the self-help heath checker.

Research Tools

Observation Sheet

The observation sheet is made and adopted by observers in the observation room. The observers carefully capture how the system of self-help heath checker assisted subjects to finish tasks, as well as subjects' subjective reactions (such as facial expressions, emotional reactions, body languages, the words spoken out, etc.) The observation sheet consists four pieces of information: 1) What observers see 2) What observers hear 3) The time length of each task begins and ends 4) Analysis of usability improvement.
Table 1. Observation Sheet.

<table>
<thead>
<tr>
<th>Observation feedback (observers)</th>
<th>Feedback of subjects</th>
<th>Time/sequence</th>
<th>Analysis from usability improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>See</td>
<td>Hear</td>
<td>Record</td>
<td>Think/judgment</td>
</tr>
</tbody>
</table>

**Questionnaire**

After the testing task was completed, a short interview took place between another tester and the subject in the test room. The following questions were addressed: 1) What is your overall impression when using the self-help health checker? 2) How well did you feel guided by the system to solve your tasks? 3) Is the menu self-explaining enough? 4) Did you understand the process pretty well? 5) How well did you feel supported by the system or menu when using the blood pressure measurement device? the blood oxygen measurement device? the electrocardiogram measurement device? the weight measurement device? 6) What general improvement suggestions can you give for the self-service health checker system and user interface? 7) Demographic data: age/education level/family status/any kind of disabilities?

**Results and Findings**

After the testing and discussion finished, the usability testing results about the self-help health checker were also structured and clarified:

**For the Self-help Health Checker Product**

1) The overall system of self-help health checker lacks strong logic link. It manifested that the start-up and response time lasts long; the language transformation from complex Chinese characters to simplified Chinese characters works badly; the selection of color distribution is illogically; the shape of buttons do not stick out; the sign and English abbreviations are not understandable for the elderly people. There is no signal showing when the system starts, ends, how many minutes left for a task; when users wrongly operate the self-help health checker, it cannot be canceled or stopped. Elderly people have difficulty in logging in the system as some of them could not remember their own ID numbers. 2) The interface of self-help health checker is also badly designed. The most important part could not be focused on the screen distribution. The touch screen was not sensitive enough for subjects to click a button. 3) The blood pressure measurement function. At the device level, subjects could not fix the cuff by oneself on the one hand, and some of them could not fix the cuff in the right way on the other hand. At the system level, the instructions were not clear enough, the "start" buttons was not distinct enough, no signal show task starts and ends, and slow response speed were the main problems. 4) The blood oxygen measurement function. At the device level, the navigation is not clear; at the system level, the same problem of instruction and signal occurred with the blood pressure measurement function. 5) The electrocardiogram measurement function. At the device level, the sub-procedure for this function is rather complicated, also lacking clear instruction. The "start measuring" and "upload" buttons are symbols and English, causing difficulty for the elderly people to figure out their meanings. At the system level, the instruction pictures works bad, i.e. the stability is bad. 6) The weight measurement function. The unclear instruction, lack of guiding signals and long response time
of the system appeared in this function. Besides, a sub-interface is needed to finish this task, but the interface is not at the right size, i.e. it is small for the elderly to read. 7) The printout. There are charts, tables and values in the table. For the charts, the significations of certain "dots" are not clear-cut; for the tables, the way of arranging values and their according standard values scope are different in Taiwan and mainland China; for some values, its' hard to know the meaning of some professional data (like the electrocardiogram).

**For the Design of Products and Services for the Elderly People**

Through this usability testing of self-help health checker, we found that: 1) For the human-machine interaction products or services, the system should be designed with strong logic. Take the measuring of electrocardiogram task for example, even the middle-aged subject with high education background took a long time (around 15 minutes) in figuring out both the procedure and the operation of system and devices. It is not hard to see that how hard this task is for the elderly people. 2) For the layout of the interfaces, it should be designed to clearly differentiate every functional part or instruction part. A product is not a good one if users could not find where to log in, how to start measuring, could not get help or easily read the instruction at the first time. The products and service for elderly users should be particularly easy and simple. 3) For self-help products, the language and signs should be carefully chosen. The words, signs are important hints for users to use such kind of products. If the products are imported overseas, the translation and localization to target language should be properly done; the chosen signs should be universal, unambiguous, and understandable; the relating unit (like measuring unit) should be in accordance with local habit. 4) For self-help products, clear instructions are extremely important. In this study, it is the first time for the subjects to use the products, they are asked to finish the measuring tasks by themselves. When they have no idea how to move on, they resort to instructions, but unluckily the instructions are not so visual or transpicuous enough.

**Usability Testing Technique**

This study showed that for elderly people-oriented products and services, usability testing is a good method to see to what extent they fit for elderly people, how far it is from "usable" to "user-friendly", and predict the degree of acceptance in the target market, and finally, to make improvements accordingly.

**Comparison of Observation and Questionnaire Results**

From the observation, we saw a lot of problems with the system, interface, devices, etc., and also subjects' "just-so-so" experience with the self-help health checker. But we get most positive answers from subjects' questionnaire sheets. Two reasons may explain this: the elderly people may be afraid of others thinking him/her as "not so clever" if they speak 100% truth of their feelings toward the product; or the elderly people were trying to say some "good" words about the product out of politeness because they were invited to use it.

**Implications**

Through this study, we can also get implications for the design of human-machine interactive products/services for the elderly people in academic circle and in market scope.
The Control of Product Quality

1) The service system in human-machine interactive products should be logic and stable. To deliver service excellence, the service logic should be scientific and systematic, the navigation system should be clear-cut, the software should be stable, and the hardware should be of excellent quality. 2) The service process should be optimally designed. Both the overall service process and each sub-process should be clearly defined and demonstrated. To achieve this, the service blueprint method should be used when designing services. 3) The service interface should be carefully designed and with a user-centered view. The service interfaces contain all "touch points" that the users interact with the whole service system. The service designers must think whether the users can easily find the log-in part, the start-up, continuing and ending signals; whether the uses can understand the words, signs as they do; whether the instructions are clear for everyone, especially for the elderly people.

The Design of Products and Services for the Elderly People

1) User-friendliness for the elderly people. The aged people commonly have bad eyesight or hearing, so the size of characters on the screen or printout should be large enough; sometimes adding a sound hint is necessary. The elderly people could not get used to new sci-tech products very quickly, then we must make the "register" procedure simple and fast; we must allow them to make "mistakes" when interacting with the system, and more importantly, giving them the right to cancel if they notice something wrong. 2) Emotional support. We should give the elderly people emotional support when designing products and services. For example, change the pamphlet instruction into video instruction, giving encouraging and comforting hints if the elderly people did wrongly, using bright colors on the screen and make the different colors distinguish with each other. 3) Safety usage and standard operation. We should ensure the elderly people could clearly wear the blood pressure monitor cuff. We should not ask the elderly people to do tasks that we do not have the according qualifications for safety purpose.

The Implement of Usability Testing

1) Preparation for usability testing. Trial test session is needed before the usability testing to ensure everything is ready and working. Time arrangement and control is important for the researchers to have enough time for discussion, for the observers to balance time to focus on observation, and not keeping the elderly people waiting long. 2) Implementation for usability testing. For testers, try not to giving the subjects too much guidance and help as the target product is a "self-help" one; for the observers, they should be ready to observe as soon as the test session starts. Do not allow any disturbance during the test sessions. 3) Team role play and contribution. For the service designers developers, we should decide when to participate, when to quit, and when to join discussion. For the testers, they should give right welcome and instructions of testing tasks. For observers, they should carefully record subject's word, actions, and body languages. For survey interviewer, they should ask questions with the subjects in a relaxed way. 4) Selection of subjects. Select different types of people to perform the test (e.g. different kind of abilities or disabilities; knowledge and educational background, age, etc.) to make better explanation and comparison of testing results. 5) Testing results and feedback. Be aware of the fact that the inconsistence between what the subjects actually meet during the testing and what he/she speaks and writes about the feedback in the questionnaire.
The "face" phenomenon may occur in China's cultural background. Do combine the feedback results and the observation results together!

Limitations

Although the usability testing in this study was implemented well, there are still some limitations for future improvement. For example, the time control and connecting is not so good, some elderly people waited a long time; the tester could not help giving instructions at the very beginning; the elderly people are not used to the "think aloud" method. These factors will be taken into consideration in the future design of usability testing.

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