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Acceptability of Robots to Assist the Elderly by Future Designers: A Case of Guangdong Ocean University Industrial Design Students

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Abstract: The development of robot technology provides many possibilities for the life support of the elderly. This study explored the acceptability of robots to assist the elderly from the perspective of future designers. A quantitative questionnaire (58 copies) and a qualitative one-to-one interview (10 people) were conducted to explore the attitude of future designers towards the use of robots to assist the elderly. One-sample Wilcoxon signed-rank test statistic was used to analyze the data of the questionnaire. The results show that the mean and median of 11 of the 12 dimensions of the acceptability questionnaire are greater than 3 (3 represents uncertain and neutral attitude), and 10 have statistical significance ($p < 0.05$). Also, the interview results show the positive attitude of future designers. The research shows that future designers hold a positive and open attitude towards the use of robots to assist the elderly. The research findings can help people understand the attitude of future designers and provide some reference for subsequent robot design and development.

Keywords: assistive robots; the elderly; acceptability; designers; potential users

1. Introduction

1.1. Aging Trend and Demands of the Elderly

In recent years, the world has seen an increasing growth rate in aging, much faster than in the past [1]. It is estimated that by 2060, the population of the elderly over 65 years old will account for about 30% of the total population in Europe [2], and 37% of the total population in Japan by 2050 [3]. In 2017, in China, 158.31 million people were the age of 65 and above, and number is predicted to rise to 336 million by 2050, accounting for about 1/3 of the total population [4]. According to the global report on aging and health by the World Health Organization, by the middle of this century, apart from many countries in Europe and North America, the proportion of the elderly population in Chile, China, South Korea, Thailand, Vietnam and other countries will exceed 30% [1].

The elderly living independently in their own homes or communities, rather than in nursing homes is called "aging in place" [5]. Research shows that the elderly prefer to live in their own homes [6–8], because it can bring them security and comfort [9]. In 2015, 32.1% of the elderly in Europe lived alone [10], which required tremendous manpower and material resources. Also, independence and autonomy are also crucial for senile dementia patients [11]. Therefore, the elderly need help in basic functions regarding personal health and activities of daily living (ADLs) [12]. In this regard, modern technology should be adopted to address aging-related issues such as shortage of professionals and high health care costs in a bid to satisfy demands of the elderly to live independently at home, in hospitals and other institutions, and to provide independent life and high-quality health care to the elderly.

1.2. Robot Assistance to the Elderly

In recent years, the rapid development of robot technology has aroused people's interest in using robots to care for and accompany the elderly [13–17]. Robots indeed play a vital role in helping the elderly [18]. For example, the seal robot Paro developed in Japan was developed to meet the psychological and companionship needs of the elderly in hospitals, especially those with dementia [19,20]. Robots can assist the elderly in preparing meals [21], lifting heavy objects [22], offering companionship [23], facilitating social interaction [24], and serving as therapeutic tools [19]. The development of humanoid robot Zora [25] and the telepresence robot Double [24] are precisely for the purpose of companionship, interaction, and treatment. In addition, robots can provide physical care, social and medical assistance to the elderly [26] and can also assist doctors in providing intelligent tool services beyond human limits [27]. For example, robots may assist caregivers in lifting bedridden patients [28]. The research of Broadbent et al. [29] pointed out that robots are also useful in making phone calls and taking blood pressure measurements.

In addition, the multifunctional mobile robot Cafero has been applied to elderly care by virtue of its technical functions including telephone calls, fall monitoring, drug management, and entertainment [30]. The robot bathtub with automatic bathing and other functions has also been developed [31]. In the research literature of Broekens et al. [32], there was qualitative and quantitative evidence revealing that the use of robots in elderly care reduces pressure of the elderly, increases their communication, reduces loneliness, improves health of the elderly, and has a positive effect on the physical and mental health of the elderly. Robots may provide support for the elderly, relatives, and caregivers [33,34]. Therefore, in the context of increasing aging, robots are a solution to solve problems related to daily life activities, home care, hospital care, company, and so on [34–38].

1.3. Research on Acceptability of Robots

In recent years, relevant researches on robot acceptability among different groups have been carried out, such as the elderly [22,32,39–41], caregivers in institutions for the aged [42,43], family caregivers [44], and health care students [45]. According to the research of Broadbent et al. [22], the elderly residents in retirement villages have a more positive attitude towards assistive robots than their families and caregivers. Heerink et al. [46] studied the acceptability of iCat assistant robots by the elderly and found that the elderly preferred robots with strong sociable capacity. They also found that there is a gender difference in the attitude towards robots. Men prefer to use robots for assistance, while women prefer to try to complete tasks themselves rather than using assistive tools such as robots. Beer et al. [39] visited 12 elderly Americans and observed the demonstration of function tasks conducted by a mobile robot arm in their home environment. The results showed that the demonstration of the mobile robot arm affected the acceptability of the elderly. The elderly were more open to robot assistance after the demonstration. In addition, Lukasik et al. [42] studied the attitude of 252 potential users from five European countries on using robots to improve nutritional support for the elderly. The results showed that most participants positively evaluated the possibility of using robots to improve diets of the elderly. Rantanen et al. [44] studied the attitude of Finnish family caregivers towards care robots through questionnaires. The research found that the perception of caregivers towards the usefulness of care robots affects their behavioral intentions when using robots. Van Kemenade et al. [45] studied acceptability of different types of care robots by medical health care students in Holland through questionnaires. The results showed that compared with monitoring and assistive robots, medical health care students have higher acceptability of companion robots. Coco et al. [43] collected data from caregivers in home care institutions and nursing homes in Japan and Finland in 2016 to compare and analyze attitudes of caregivers in Finland and Japan towards elderly care robots. The research showed that Japanese caregivers have a higher evaluation on the practicability of robots than Finnish caregivers. Also, due to cultural differences, caregivers in these two countries have different understandings of the importance of tasks of care robots.

As discussed above, previous researches mainly focused on the acceptability of the elderly, caregivers in institutions for the aged, family caregivers, and health care students, but rarely paid attention to the acceptability of designers, especially attitudes of future designers to the use of robots among the elderly. However, understanding their attitude may be equally important to the success of robots, because the attitude of designers towards the use of robots to assist the elderly will also affect the shape, function, and structural design of subsequent robots to a certain extent. As research [47,48] points out, in addition to users, it is of great importance to understand the acceptability of certain professionals, such as future designers who study industrial design. Therefore, it is very practical to conduct robot-assisted acceptance studies for future designers who study industrial design. They are the future designers, and likely to be robot shapers or robot structural designers.

1.4. Research Purpose

However, according to the above discussion and analysis, most of the previous studies are conducted from the perspective of elderly users, and there is no research from a future designer perspective. Therefore, this study intends to explore the acceptability of future designers to use robots to assist the elderly. More specifically, the goal of the current study was to determine whether future designers are open to accept robots to assist older adults in the home. Understanding the attitude of future designers towards assistive robots for the elderly may help people, especially designers, to understand the view of designers in this aspect, and further help to guide designers to design robots with higher acceptability. In addition, these future designers are potential users of robots in the future. Therefore, understanding the attitude of this special group (both robot designers and potential users) towards robots is of great practical significance.

1.5. Novelty of Research

This study is novel in the following three aspects. First of all, our research subjects are not the elderly [22,37,49], institutional nurses [43,50], informal caregivers [51] or home caregivers [44], but future robot designers. By exploring the attitudes of future designers to the use of robots to assist the elderly, people (e.g., other designers, researchers, engineers) can understand the attitudes of future designers to the use of robots, so as to drive designers to recognize that users (e.g., the elderly) can be regarded as the priority for design and finally design assistive robots that meet the needs of users. Our research subjects are Chinese, unlike other research whose subjects were Japanese [43,52], Europeans [42,51,53–57], and Americans [37,39,49,58]. In this way, we may enrich people's understanding of viewpoints of research subjects from different cultural backgrounds. Finally, the research method used in this study is different from previous ones. Previous research was conducted through e-mail [59] and online questionnaires, failing to present robots for participants in an intuitive manner. In this study, participants started to fill in the questionnaire after watching a robot video [60], which to a certain extent enables participants to have a clearer understanding of the research topic and provide more real research data.

2. Methods

2.1. Technology Acceptability Model and Questionnaire

2.1.1. Technology Acceptability Model

Attitudes toward technology can be predicted through the acceptability model, and research on the technology acceptability model can be traced back to the technology acceptability model (TAM) proposed by Davis [61]. In the TAM, "perceived ease of use" and "perceived usefulness" are regarded as the main influencing factors that affect the user's intention to use the system [62]. The TAM has been applied to the discussion of different types of technology acceptability by some researches and further expanded in later researches.

Venkatesh et al. [63] put forward the Unified Theory of Acceptability and Use of Technology (UTAUT). The UTAUT is an extension of the TAM. The model provides a more in-depth understanding of technology acceptability prediction factors [64]. The UTAUT proposes four constructs on the basis of the TAM, which are performance expectancy, effort expectancy, social influence, and facilitation conditions [63]. Research of Venkatesh et al. [64] showed that the technology acceptability model can predict technology acceptability attitude, and the UTAUT model has also been used in the study of acceptability attitude [65]. Adopting the UTAUT model proposed by Heerink et al. [66], this study intends to explore the attitudes of future designers (and potential users) towards the use of robots to assist the elderly. Such a model has been widely used in other studies [67,68] to evaluate the acceptability of robots. Research results show high reliability.

2.1.2. Acceptance Questionnaire

In the UTAUT model, the user's acceptability of technology is obtained through a number of factors that may affect the acceptability. These factors are called "construct", and each construct is represented by a corresponding question. This study used the questionnaire designed by Heerink et al. [62]. The questionnaire consists of 12 constructs and 41 questions (see Appendix A). The questions are translated into Chinese to facilitate understanding of the subjects. The Likert's five-point scale was adopted to score answers of participants for problems of each construct (1 = totally disagree; 2 = disagree; 3 = uncertain; 4 = agree; 5 = totally agree). We analyzed the reliability of the questionnaire and calculated Cronbach's alpha value [69]. Score of all constructs exceeded 0.7, indicating that the constructs of the questionnaire were reliable. The score of each construct is shown in Table 1. The Cronbach's alpha value of all items is 0.869, indicating sound internal consistency reliability.

Table 1. Constructs with Cronbach's alpha.

Code	Construct	Num. Items	Cronbach's Alpha
PENJ	Perceived enjoyment	5	0.759
ATT	Attitude	3	0.752
ANX	Anxiety	4	0.753
FC	Facilitating conditions	2	0.808
ITU	Intention to use	3	0.836
PAD	Perceived adaptability	3	0.777
PEOU	Perceived ease of use	5	0.749
PU	Perceived usefulness	3	0.772
PS	Perceived sociability	4	0.828
SI	Social influence	2	0.808
SP	Social presence	5	0.741
TR	Trust	2	0.737

Note: the score with all the items was 869.

2.2. Interviews

In order to understand the feelings and thoughts of participants, after watching the video, we conducted a one-on-one interview with a total of 10 participants. The whole interview lasted for about 40 min. The topics of the interview were centered on the following two questions: (1) Do you think the use of robots can help the elderly to carry out their daily activities better? (2) If robot technology is mature, do you think the elderly will use assistive robots? Why?

2.3. Experimental Setting

2.3.1. Robot ElliQ Video

This study chose network video with robot ElliQ [60]. ElliQ is a social home robot for older adults. ElliQ weighs 3.5 kg and consists of a robot body, base, and screen. ElliQ is specially designed for the

elderly to facilitate their daily life. With video calls and messaging, music and video playing, cognitive stimulation and games, photo sharing, daily routine reminders, calendar and reminders, news and weather, question and answer, and other functions, it can recommend music or videos users may like, remind daily activities such as walking or taking medicine and facilitate the elderly to get in touch with the outside world. The elderly can communicate with ElliQ through voice. When interacting with user, the head of ElliQ will swing and shine. Its body language can intuitively explain users' deeper understanding and communication.

2.3.2. Participants

This study invited a total of 58 participants, including 32 males (55.2%) and 26 females (44.8%), with an average age of 21.38 years (range = 20–23, standard deviation (SD) = 0.721). All were Chinese and third-year undergraduate students majoring in industrial design from the School of Mechanical and Power Engineering of Guangdong Ocean University. The school is located in Zhanjiang City, Guangdong Province, China. These students were about to complete a three-year undergraduate course. In the future, they may become industrial designers, robot designers, robot shapers or robot structural designers. In terms of robot use experience, 30 (51.7%) said they had seen robots in exhibition halls, TV, and newspapers, 11 (19%) said they did not have any robot use experience, and 17 (29.3%) said they had used and operated robots.

2.3.3. Experimental Program

The experiment was conducted in the classroom. Prior to the experiment, the researchers introduced the relevant information of the study to the participants. After that, all participants signed the informed consent form and completed the demographic questionnaire. The whole experiment lasted about 80 min and was divided into two parts. In the first part, 58 participants completed the acceptability questionnaire after watching the ElliQ robot video. In the second part, in order to encourage participants to express their ideas and provide more information for the study, we conducted a one-to-one interview with a total of 10 participants (5 male and 5 female). It should be noted that prior to the first part, the researchers briefly introduced the situation of the robot and told the participants that the functions of the assistive robots are far more than those shown in the video. During the video playing process, the researchers also further explained the robot demonstration content. The photos of the experimental process are shown in Figure 1.

Figure 1. Participants watched the robot video.

2.4. Data Analysis

All questionnaire data were calculated by SPSS 25 software. Firstly, the average score of problems of all items was used to calculate the score of each construct, and then basic descriptive statistics were carried out, including range, mean (if equal to 3, it represents that participants hold a neutral attitude; if less than 3, it represents that participants hold a negative attitude; if exceeds 3, it represents that participants hold a positive attitude), and standard deviation. Considering that the sample size was not very large, we adopted a nonparametric statistical method, mainly including the one-sample Wilcoxon signed-rank test statistical method and compared the average score of each construct with the median 3 (3 represents uncertain). The interview materials were transcribed word by word through the network transcription platform [70] of a professional transcription company, and then the researchers proofread the transcription results word by word in combination with the audio files to ensure that the transcribed text materials were consistent with the interview contents.

3. Results

3.1. Questionnaire

The Cronbach's alpha value of the whole questionnaire is 0.869, and the Cronbach's alpha value of each construct is shown in Table 1, which indicates that the internal consistency of the constructs of the questionnaire is reliable. Table 2 shows descriptive statistics of each construct, including range, mean, etc. As shown in Table 2, among the 12 constructs of the acceptability questionnaire, the average score of the anxiety (ANX) construct is lower than 3 (3 = uncertain), and the average score of the other 11 constructs is greater than 3, especially the average score of attitude (ATT), perceived adaptability (PAD), and perceived usefulness (PU) constructs which is nearly 4. In order to know the attitude in detail of future designers towards the use of robots to assist the elderly, we conducted one-sample Wilcoxon signed-rank tests. By comparing the median of the constructs of the acceptability questionnaire with 3 (3 represents uncertain and neutral attitude), we found that the median of 9 of the 12 constructs was greater than 3, and the median of 3 constructs was 4, which were respectively the ATT, PAD, and PU constructs. In addition, the median of facilitating conditions (FC) and trust (TR) constructs is 3, while the median of the ANX construct is less than 3. The research shows that the median number of most constructs in the acceptability questionnaire exceeds 3, and the *p*-value of a total of 10 constructs is less than 0.05, which indicates that such constructs are of statistical significance. Compared with the neutral attitude, future designers are willing to accept the assistance of robots for the elderly. The results show that future designers hold a positive attitude towards using robots to assist the elderly.

Table 2. Acceptability of robots to assist the elderly by future designers (n = 58).

Code	Mean	Median	SD	Range	*p*-Value *
PENJ	3.43	3.60	0.615	1.20–4.40	0.000
ATT	3.89	4.00	0.597	2.00–5.00	0.000
ANX	2.80	2.75	0.695	1.50–4.25	0.034
FC	3.36	3.00	0.831	2.00–5.00	0.004
ITU	3.13	3.17	0.812	1.00–4.67	0.192
PAD	3.82	4.00	0.650	2.00–5.00	0.000
PEOU	3.74	3.80	0.559	2.40–4.80	0.000
PU	3.81	4.00	0.589	1.67–5.00	0.000
PS	3.30	3.50	0.724	1.00–5.00	0.001
SI	3.41	3.50	0.691	1.50–5.00	0.000
SP	3.11	3.20	0.745	1.20–4.60	0.110
TR	3.28	3.00	0.708	2.00–5.00	0.004

Note: * one-sample Wilcoxon signed-rank tests. Abbreviation: SD, standard deviation. Range, minimum–maximum.

3.2. Interviews

The one-to-one interview results show that most future designers will maintain a more positive and open attitude towards using robots to assist the elderly. Regarding the question, "Do you think the use of robots can help the elderly to carry out their daily activities better?", answers of future designers were mainly given from two aspects of the elderly's physical condition and family status. The main answers are as follows:

"Some old adults are in poor health and lack strength, while some are lazy and do not want to do housework. Using robots can help them do some housework." (Interviewee 2, female, age 21);

"For the elderly, robots are a kind of companion, while for parents (children of the elderly) or family members working outside, it is a kind of security to check the situation of the elderly at home through robots." (Interviewee 6, female, age 21);

"Robots can help the elderly. There are many things that the elderly want to try but cannot try. Robots can better help them to do these things. However, there is a problem. The cost of learning to use robots by older adults may be too high. The elderly want to use robots, but they may not know how to use them." (Interviewee 8, male, age 21);

"It is helpful, because I think the elderly sometimes have some sudden diseases, and then if our parents or young people are not at home, there is no way to know these sudden emergencies of the elderly or some living conditions of the elderly at ordinary times because of work or for other reasons. Therefore, if there is a robot with medical equipment that can often help us monitor the physical condition of the elderly, we will feel relieved." (Interviewee 7, female, age 21).

"The elderly are not able to move easily when they get older. Their families cannot stay at home because of work. Also, some people worry that some caregivers may abuse the elderly. However, if robots are used, these worries and other worries may be reduced." (Interviewee 9, male, age 22).

Additionally, in regard to the question "If robot technology is mature, do you think the elderly will use assistive robots? Why?", future designers hold a positive attitude. Their answers are mostly based on the actual needs of the elderly:

"The elderly will use robot assistance, because robots can improve efficiency and help save time. For example, when cooking, a robot nearby reminds them what to do next, which is much better than looking at recipes with a mobile phone and will improve efficiency." (Interviewee 9, female, age 22).

"To some extent, the use of robots can improve efficiency of life and work and conveniently fulfill daily needs, such as reminding the elderly to take medicine or helping the elderly to go to the toilet." (Interviewee 2, female, age 21);

"It would be wonderful if there is a robot that can help to take care of the elderly, or remind the family of daily chores and things that are easy to forget." (Interviewee 7, female, age 21).

"Without companionship, the current elderly (or when I grow old), may choose to accept assistance from robots, such as accompanying them in sports, watching TV and discussing TV content. It is quite good to be able to communicate with robots like friends." (Interviewee 1, male, age 21).

In addition, some interviewees also said that although robots may assist the elderly, the operation of robots may be affected due to reasons of the elderly or product factors. For example, the third interviewee said that "it should be possible when the technology is mature or some technologies can really enable the elderly to accept robots, but it may be difficult for them to use such robots because the elderly are of different education levels." (male, age 21); The fifth interviewee also said, "If the technology is mature, the elderly should use robots as aids, because many elderly people are at home by themselves, and it is much more convenient to have a robot. However, if the technology is not mature, the elderly will not be able to operate it very well, because it is very difficult for some elderly people to learn how to operate and use robots." (male, age 21).

4. Discussion

Robot assistance is a good solution to aging-related problems [71,72]. In this study, the acceptability of future robot designers to robot assistance to the elderly is discussed through a combination of

quantitative and qualitative methods. Based on the quantitative and qualitative data analysis of 58 questionnaires and 10 participants, the results show that future robot designers will maintain a positive and open attitude towards using robots to assist the elderly. The research findings may help people, especially robot designers (including future robot designers or designers who are now engaged in robot design) to understand the attitude of their peers in this "role" of robots to assist the elderly, thus guiding the development of assistive robots that are more in line with the acceptability of the elderly and improving the quality of life of the elderly.

In this study, through the statistical analysis of 12 constructs in the acceptability questionnaire, 10 constructs are of statistical significance, indicating that future designers are open to the research topic. It is worth noting that the mean and median of the attitude (ATT) construct are the highest, indicating the most positive attitude. However, the lowest average score in the anxiety (ANX) construct also reflects to a certain extent that these young future designers are not anxious or afraid of using new robot technologies, which is precisely an expression of an open attitude. Of course, people's positive attitude toward robot-assisted seniors may be more based on the needs of the older adults, high care costs, and lack of manpower. However, because the robot may invade an individual's privacy, the assistance of the robot means the user loses their own control, and even has a negative influence such as loss of self, etc. [73], which also affects the attitude towards robots. At the same time, due to the appearance of the robot and the emotion, values, and other factors reflected in the human–robot interaction process [73], some older adults may still not buy robots because of factors such as social pressure [74].

Although future designers are optimistic about robots assisting the elderly, research also shows that these designers are worried that factors such as the education level of the elderly themselves may affect the use and acceptability of robots by the elderly. For example, the third interviewee said that it should be possible when the technology is mature, or when some technologies can really make the elderly accept robots. However, due to the educational level of the elderly, there may also be difficulties in their use (male, age 21). Such worry is similar to some research results, namely, compared with those young people who have received more education, the elderly find it difficult to use scientific and technological products due to their lower educational level [75]. Additionally, education is also related to perceived sociability [76]. This shows that education level is one of the factors that affect users' acceptability of new technologies such as robots [77]. In addition, in interviews with future designers, they also said that when people born in the 1980s and 1990s get older, they will have a higher acceptability of new technologies such as robots, and the cost of learning to use robots will not be as high as those of the current elderly. Therefore, it is necessary for future research to further consider such factors as education level and learning cost that affect users' use or acceptability of new technology products.

Moreover, the study also found that future designers in Guangdong Ocean University believe that some traditional concepts of the elderly will affect the elderly's understanding of robots. For example, a female interviewee said, "For my grandparents, they may feel scared, untrustworthy and unsafe when they see robots. Some of their ideas are deep-rooted" (Interviewee 6, female, age 21). This shows that when conducting cognitive research on new technologies such as robots at different ages, factors that affect users' cognition, such as era background and limitations, should be considered so as to have a more comprehensive understanding of their views on new technologies. Older adults are an asset in the process of innovative design [78]. As Wounhuysen [79] said, in addition to participating in questionnaires and focus groups, they should also participate in the design process and work with designers. Their life experience plays an important role in the innovative design of products and services [78]. However, older adults' perceptions of design have never been or are rarely considered [80]. Therefore, older adults should be involved in the design process of social robots and their opinions should be listened to [73].

On the whole, our quantitative and qualitative research shows that these future designers maintain a positive and open attitude towards the use of robots to assist the elderly. This view is similar to

related research, that is, people born around the millennium are technical experts who are receptive to new technologies [81]. As the eighth interviewee said, as depicted in Doraemon (Japanese science fiction comedy cartoon), in the 22nd century, robots not only serve as teaching tools for children, but serve the entire human race, including of course the elderly. They may help solve many trivial affairs, such as some easily forgotten things, and are indispensable assistants in our human society (male, age 21).

Our research also has certain limitations. First of all, previous studies [82] showed that people of different nationalities have different perceptions and evaluations on the sociability and usefulness of robots; therefore, since the nationality of subjects in this study is Chinese, the general applicability of the research results is limited to a certain extent. In the future, this study may try to carry out relevant research on future designers or professional designers of different nationalities to evaluate the impact of culture on the results. In addition, future studies should also focus on gender, level of education, and comparative research in several countries. Furthermore, the main limitation of this study lies in the sample size, and more samples will provide more reliable results. Obviously, the qualitative research of small samples has also obtained interesting findings in previous related studies [83,84]. In subsequent studies, we should expand the scale of participants as much as possible. Finally, previous researches [59] only used research methods such as mailed questionnaires and failed to provide participants with an intuitive view of robots. Although this study added a robot video, it should try to engage participants in interaction with real robots as much as possible in the future.

5. Conclusions

In this study, we conducted a quantitative questionnaire among 58 participants and a qualitative one-to-one interview for 10 of them, and in doing so we studied the acceptance of robot-assisted older adults and determined future designers' attitudes towards the use of robot-assisted seniors. All participants showed a positive and open attitude towards using robots to assist the elderly. Among the 12 constructs of the questionnaire, 58 future designers obtained higher scores for 10 constructs, which are statistically significant ($p < 0.05$). Meanwhile, 10 participants of the one-to-one interview held that it is good and acceptable to use robots to assist the elderly and expressed a more positive view. In addition, they also pointed out that the acceptability of assistive robots may be influenced by the education level of the elderly, their concept of robots, and the factors of learning cost. The results of the questionnaires and interviews indicate that future designers will maintain a more positive attitude towards the use of robot-assisted seniors. This study will help people understand the acceptability of using robots to assist the elderly from a new perspective of future designers, so as to promote designers to design robots that conform to the elderly and improve the quality of life of the elderly.

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Appendix A

Questionnaire

Number	Items
1	I enjoy the robot talking to me
2	I enjoy doing things with the robot
3	I find the robot enjoyable
4	I find the robot fascinating
5	I find the robot boring
6	If I should use the robot, I would be afraid to make mistakes with it
7	I think it is a good idea to use the robot
8	The robot would make my life more interesting
9	It is good to make use of the robot
10	If I should use the robot, I would be afraid to break something
11	I have everything I need to make good use of the robot
12	I find the robot scary
13	I know enough of the robot to make good use of it
14	I find the robot intimidating
15	I think I'll use the robot during the next few days
16	I am planning to use the robot during the next few days
17	I think the robot can be adaptive to what I need
18	I think the robot will only do what I need at that particular moment
19	I think the robot will help me when I consider it to be necessary
20	I think the robot is useful to me
21	I am certain to use the robot during the next few days
22	I think I will know quickly how to use the robot
23	I find the robot easy to use
24	I think I can use the robot without any help
25	I think I can use the robot when there is someone around to help me
26	I think I can use the robot when I have a good manual
27	It would be convenient for me to have the robot
28	I consider the robot a pleasant conversational partner
29	I find the robot pleasant to interact with
30	I feel the robot understands me
31	I think the robot is nice
32	I think the robot can help me with many things
33	I think the staff would like me using the robot
34	I think it would give a good impression if I would use the robot
35	I would trust the robot if it gave me advice
36	When interacting with the robot I felt like I am talking to a real person
37	It sometimes felt as if the robot was really looking at me
38	I can imagine the robot to be a living creature
39	I often think the robot is not a real person
40	Sometimes the robot seems to have real feelings
41	I would follow the advice the robot gives me

Note: response options, 5-point Likert scale from "totally disagree" to "totally agree".

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