論文 / 著書情報
Article / Book Information

Title	Dimensions of People's Attitudes toward Robots
Author	Daisuke Suzuki, Hiroyuki Umemuro
Journal/Book name	Proceedings of the 7th ACM/IEEE International Conference on Human-Robot Interaction, , , pp. 249-250
発行日 / Issue date	2012, 3

Dimensions of People's Attitudes toward Robots

Daisuke Suzuki[1] Hiroyuki Umemuro[2]
Department of Industrial Engineering and Management, Tokyo Institute of Technology
2-12-1-W9-67 Ookayama, Meguro-ku, Tokyo 152-8552, Japan
+81-3-5734-2246
[1]suzuki.d.ad@m.titech.ac.jp, [2]umemuro.h.aa@m.titech.ac.jp

ABSTRACT
The purpose of this study was to investigate dimensions that construct people's attitudes toward robots. In the first phase, investigations using free description and group interview were conducted to extract potential elements for attitudes toward robots. In the second phase, a questionnaire battery was developed based on the elements extracted, and a survey investigation was conducted with the questionnaire. A factor analysis was conducted on the responses to the questionnaire, and nine factors were extracted as dimensions of people's attitudes toward robots.

Categories and Subject Descriptors
H.1.2 [**Models and Principals**]: User/Machine Systems – *human factors.* K.4.2 [**Computers and Society**]: Social Issues.

General Terms
Human Factors.

Keywords
Attitude, acceptance.

ACM 978-1-4503-1063-5/12/03.

1. INTRODUCTION
Robots are entering the domestic environment and can be helpful in our everyday lives. Older people may especially benefit from robots that support independent living in their own home of choice and community in a confident and comfortable manner.

On the other hand, robots can be perceived as too innovative a technology and may not be accepted, even though they are helpful. Therefore, it is essential to understand people's perceptions of robots. Research has been conducted to understand people's acceptance of domestic robots [1][2]. In particular, people's attitudes toward robots have been studied in relation to their acceptance [7][12]. However, individual differences in attitudes have not been fully studied.

As methods of measuring individual attitudes toward robots, the Negative Attitudes toward Robots Scale and Robot Anxiety Scale [10][11] have been proposed. However, these attitude scales measure only negative attitudes toward robots. Although negative attitudes are considered a good predictor of the success of human-robot interaction, people's attitudes may have more complex constructs. Studies on people's attitudes toward computers reveal multiple dimensions of computer attitudes. For example, Loyd and Gressard [8] reported three dimensions: liking, anxiety, and confidence. Jay and Willis [6] reported seven dimensions: comfort, efficacy, gender equality, control, dehumanization, interest, and utility. Hence, for better understanding of individual attitudes toward robots, multi-dimensional constructs of attitudes should be studied.

HRI'12, March 5–8, 2012, Boston, Massachusetts, USA.
ACM 978-1-4503-1063-5/12/03.

The purpose of this study was to investigate dimensions that construct people's attitudes toward robots. To include broad dimensions of attitudes, potential elements were extracted from people's free descriptions and interviews. A questionnaire-based investigation and a factor analysis were conducted based on these elements to extract attitude dimensions.

2. ELEMENTS CONSTRUCTING PEOPLE'S ATTITUDES TOWARD ROBOTS
In the first phase of the study, to extract the potential elements that construct people's attitudes toward robots, an investigation with a questionnaire and interview was conducted.

2.1 Methods
2.1.1 Participants
Participants were 64 Japanese older adults over age 60 and 19 Japanese undergraduate and graduate students.

2.1.2 Procedure and Stimuli
In the first part, an explanation of one sample robot at a time was given to participants. Then participants were asked to describe their own feelings and ideas freely on the questionnaire, in response to prompts such as "intention to use", "feelings when the robot comes to your home", and "points you like or dislike about the robot". This procedure was repeated for four sample robots: Roomba [5], a home-assistant robot [3], PaPeRo [9], and Paro [4].

In the second part, participants were asked to describe their thoughts about robots in general, such as "feelings and perceptions they might have when robots are in their home" and "relations with robots compared with relations with pets or friends".

After they completed their free descriptions, they were also interviewed as a group about feelings and thoughts they had had while answering the questionnaire.

2.2 Results
All responses to the questionnaire and interview were checked manually. Keywords that appeared related to attitudes toward robots were picked out, and duplications were eliminated. Finally, 125 keywords were extracted, hereafter referred to as attitude elements. These extracted elements could be categorized into 10 groups: "performance", "communication", "physical appearance", "social factors", "physical and mental factors of users", "adoption into current environment", "family member", "relation and chemistry", "living object vs. machine" and "miscellaneous".

3. DIMENSIONS OF ROBOT ATTITUDES
In the second phase of the study, a questionnaire-based investigation was conducted to extract dimensions constructing people's attitudes toward robots.

3.1 Method

3.1.1 Participants

Participants were 66 Japanese older adults aged 61 to 87 years (M=72.5, SD=6.2) and 135 Japanese younger adults in universities aged 19 to 38 years (M=22.2, SD=2.0). Among those, 47.0% of the older participants and 77.0% of the younger participants were males.

3.1.2 Procedure and Measurement

Participants were asked to complete the questionnaire at their own pace and return it to the investigator.

The questionnaire comprised two parts. The first part asked about participants' demographic information. The second part consisted of 125 question items corresponding to attitude elements extracted in the first phase. Participants were asked to indicate how each of the items matched their feelings and perceptions of domestic robots in general, by responding on seven-point Likert scales.

3.2 Results

A factor analysis was conducted on participants' responses. The number of factors was determined by decreasing degree of initial eigenvalues. The principal factor method with varimax rotation revealed a nine-factor structure. The cumulative contribution for the nine factors was 43.42%. These nine factors were considered dimensions of peoples' attitudes toward robots.

Variables that had high loadings on the first factor included "I think of robots as family members" and "I feel comfortable with robots". This factor was considered to represent familiarity with robots and thus was labeled "familiarity".

Variables that had high loadings on the second factor included "I want to train robots to fit my preferences" and "It is fun to use robots". This factor was considered to represent engagement with robots and therefore was labeled "involvement".

Variables such as "Using robots at home is distressing", "It's shameful to use robots", and "Robots will corrupt humans" had high negative loadings on the third factor. This factor was considered to represent a sense of self-respect and was labeled "self-esteem".

Variables that had high loadings on the fourth factor included "I have sufficient ability to use robots" and "I can learn how to use robots easily". This factor appeared to represent self-confidence in using robots and thus was labeled "self-efficacy".

Variables that had high factor loadings on the fifth factor included "Family or friends will help me use robots" and "I want to use robots if everybody uses them". This factor was considered to represent relations with other people and was thus labeled "social relations".

Variables that had high loadings on the sixth factor included "Robots are cute" and "Robots are beautiful". This factor appeared to be related to aesthetic appreciation. Thus, it was labeled "appealing appearance".

Variables such as "Robots are practical" and "Robots are easy to use" had high loadings on the seventh factor. This factor was considered to represent practical utility and was labeled "utility".

Variables that had high loadings on the eighth factor included "Robots with a variety of sounds should be developed" and "Robots with a variety of shapes should be developed". This factor was considered to represent appreciation of variations, and was thus labeled "variety".

Finally, on the ninth factor, variables such as "Robots are appropriate for sensitive jobs in places like hospitals" had high positive loadings. This factor appeared to represent the idea that robots should do assistive jobs in public but not private situations. Thus, this factor was labeled "helper".

4. CONCLUSION

This study investigated dimensions of people's attitudes toward robots. Nine dimensions representing robot attitudes were extracted. Based on these dimensions, multidimensional attitude scales can be developed in future research.

5. REFERENCES

[1] Broadbent, E., Stafford, R., and MacDonald, B. 2009. Acceptance of healthcare robots for the older population: Review and future directions. *International Journal of Social Robotics*, 1, 319-330.

[2] Ezer, N., Fisk, A. D., and Rogers, W. A. 2009. Attitudinal and intentional acceptance of domestic robots by younger and older adults. *Lecture Notes in Computer Science*, 5615, 39-48.

[3] Information and Robot Technology Research Initiative. 2008. Home-assistant robot. Retrieved November 18, 2011, from http://www.irt.i.u-tokyo.ac.jp/reform/081024/index.shtml

[4] Intelligent System Co., Ltd. 2005. Paro. Retrieved November, 18, 2011, from http://paro.jp/?page_id=241

[5] iRobot. 2011. Roomba. Retrieved November 18, 2011, from http://www.irobot-jp.com/product/index.html

[6] Jay, G. M., and Willis, S. L. 1992. Influence of direct computer experience on older adults' attitude toward computers. *Journal of Gerontology: Psychological Sciences*, *47*, 250-257.

[7] Khan, Z. 1998. *Attitudes towards intelligent service robots* (TRITA-NA-P9821, IPLab-154). Sweden, Royal Institute of Technology, Numerical Analysis and Computing Science, Interaction and Presentation Laboratory.

[8] Loyd, B. H., and Gressard, C. 1984. Reliability and factorial validity of computer attitude scales. *Educational and Psychological Measurement, 44*, 501-505.

[9] NEC Corporation. 2005. PaPeRo. Retrieved November, 18, 2011, from http://www.nec.co.jp/products/robot/

[10] Nomura, T., Kanda, T., Suzuki, T., and Kato, K. 2006. Measurement of anxiety toward robots. *Proceedings the 15th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN 2006)*, 372-377.

[11] Nomura, T., Kanda, T., Suzuki, T., and Kato, K. 2008. Prediction of human behavior in human–robot interaction using psychological scales for anxiety and negative attitudes toward robots. *IEEE Transactions on Robotics*, 24(2), 442-451.

[12] Ray, C., Mondada, F., and Siegwart, R. 2008. What do people expect from robots?. *Proceedings 2008 IEEE/RSJ International Conference on Intelligent Robots and Systems, Nice, France,* 3816-3821.