Measuring perceived adaptiveness in a robotic eldercare companion

Heerink, M.; Kröse, B.; Wielinga, B.J.; Evers, V.

Publication date
2008

Published in
HRI 2008: Robotic Helpers: User Interaction, Interfaces and Companions in Assistive and Therapy Robotics: Proceedings

Measuring Perceived Adaptiveness in a robotic eldercare companion

Marcel Heerink
Hogeschool van Amsterdam
Instituut voor Information Engineering
++ 31 6 42917442
m.heerink@hva.nl

Ben Kröse
University of Amsterdam
Intelligent Systems Laboratory
++ 31 20 5257461
kröse@science.uva.nl

Bob Wielinga, Vanessa Evers
University of Amsterdam
Human Computer Studies Laboratory
++ 31 20 8884696, ++ 31 205256795
wielinga, evers{@science.uva.nl}

ABSTRACT
Based on observations in previous experiments with a robotic companion in eldercare and on findings in related literature, we developed the concept of Perceived Adaptiveness. We integrated this in our technology acceptance methodology for robotic eldercare companions and found in a small experiment that adaptiveness of the system as perceived by elderly users is indeed a relevant item, being a direct influence on Perceived Usefulness.

Categories and Subject Descriptors
H.5.2. [**Information Interfaces And Presentation**]: User Interfaces - *Evaluation/methodology.*

General Terms
Measurement, Experimentation, Human Factors, Standardization, Theory, Verification.

Keywords
Human-robot interaction, technology acceptance models, eldercare, assistive technology.

1. INTRODUCTION
When presenting a robot to elderly users in several experiments, we told our users the possibilities: it could help them remember things, it could help them control all kinds of devices, it could watch them and alarm someone if necessary and it could keep them company, play games or just chat. During and after their encounter with the robot, a repeating remark was that they would not have any use for it, because they could still remember a lot. Therefore, when questioned if they would intend to use the robot if it were available to them, they would reply negatively. When we suggested that the features they would not yet need could simply be turned of by them, or automatically by the robot itself if it would notice that there was no demand for it, the participant would change her mind and be willing to at least try to use the robot. Most of these subjects were suffering light forms of dementia.

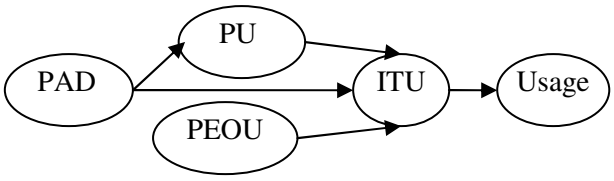
In our project, in which we aim to develop a methodology of predicting and explaining acceptance of social robots and screen agents (companions) used in eldercare [1], we are currently experimenting with the iCat robot in eldercare institutions. Motivated by our observations, which are supported by related research [2, 3], we decided to include an attempt to measure the amount in which adaptiveness of the robot was perceived and see how the results relate to scores on perceived usefulness and the Intention to Use the system.

2. MEASURING INTENTION TO USE AND PERCEIVED ADAPTIVENESS
In our study we are using a technology acceptance model (TAM) to predict and explain acceptance of eldercare companions. In its most basic form [4] this type of model states that Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) determine the behavioral Intention to Use (ITU) a system and it assumes that this behavioral intention is predicting the actual use [5-8].

Since the early nineties several other possible influences have been added for different types of technology or user groups (see [8] for an overview). The usual technique to measure these influences is by using a questionnaire containing statements that demand a reply on a likert scale (although we are also using observation techniques [9]). Each influence is represented by a few questions and the scores for the influences ('constructs') can be mapped and interrelated.

In our research, we added the construct of Perceived Adaptiveness (PAD), represented by three questions (see Table 1) in a questionnaire containing statements that demanded a reply on a five point Likert scale (totally disagree – disagree – don't know – agree – totally agree). The other constructs were Perceived Usefulness (PU), Perceived Ease of Use (PEOU) and Intention to Use (ITU). We hypothesized the score for Perceived Adaptiveness would not only relate to the score for Intention to Use, but also to the scores for Perceived Usefulness, since an adaptiveness can be seen as an aspect of usefulness of a system.

Figure 1. Applied model



We designed an experiment in an eldercare institution consisting of a short test, during which 30 participants were to meet a robot and work with it for a few minutes. These participants partly lived in the eldercare institution, partly independently in apartments next to the institution. Their age ranged from 65 to 83; six were female, four were male.

Figure 2. Setup: iCat with touch screen

The 'companion' we used was the iCat, a 80 cm high, non-mobile robot. For this experiment, we used a setup in which the robot was connected to a touch screen as is shown in Figure 1.

Participants were brought into a room were they were alone with the iCat and one researcher. They did not get any specific task, but were instructed to simply play with the robot for about three minutes. After the participants finished this session they were brought to another room where they were given the list with statements to which they could reply.

Table 1 – Statements (translated from Dutch) for Perceived Adaptiveness, Perceived Usefulness, Intention to Use and Perceived Ease of Use

Construct	Statements
Perceived Adaptiveness	I think iCat can be adaptive to what I need I think iCat will only do what I need at that particular moment I think iCat will help me when I deem it necessary
Perceived Usefulness	I think iCat is useful to me I think iCat can help me with many things
Intention to Use	I think I'll use iCat the next few days I am certain to use iCat the next few days I'm planning to use iCat the next few days I think I'll use iCat for this amount of minutes: 0 | up to 5 | 5 to 15 | 15 to 30 | more then 30
Perceived Ease of Use	I think iCat is easy to use I think I can use iCat without much help I think I'll quickly learn how to work with iCat

When analyzing the data we started with Cronbach's alpha for the used statements within the constructs. As Table 2 shows, it is never below ,7 which means we can hold the constructs to be reliable.

Table 2 – Cronbach's Alpha for the used constructs

Construct	Alpha
Perceived Adaptiveness	,834
Perceived Usefulness	,787
Intention to Use	,947
Perceived Ease of Use	,886

Next, we looked at the correlation for the constructs (Table 3).

Table 3 – Pearson correlation for the used constructs

		ITU	PAD	PU	PEOU
PAD	Pearson Corr.	,544**	1	,936**	,442*
	Sig. (2-tailed)	,002		,000	,015
PU	Pearson Corr.	,504**	,936**	1	,468**
	Sig. (2-tailed)	,005	,000		,009
PEOU	Pearson Corr.	,633**	,442*	,468**	1
	Sig. (2-tailed)	,000	,015	,009	

There was a very strong correlation between Perceived Adaptiveness and Perceived Usefulness. We decided to take a look at Cronbach's alpha for the combined construct. as shown in Table 4.

Table 4 – Cronbach's Alpha for combined constructs Perceived Adaptiveness and Perceived Usefulness

Construct	Alpha
PAD + PU	,841

3. DISCUSSION AND FURTHER RESEARCH

With the strong correlation it seems clear that the concept of Perceived Adaptiveness should somehow be represented within a technology acceptance model for eldercare companions. It is however unclear if it should be an extension of Perceived Usefulness. Possibly tests on different types of companions with different functionalities could provide more clarity.

Besides, strong correlation between Perceived Adaptiveness and the other constructs does not necessarily mean that a more adaptive system is to be accepted better. In earlier experiments [1, 10] we compared responses to a robot with more social abilities to the same robot in a less sociable condition. Participants who showed a higher appreciation for the robot's social abilities did score higher on acceptance, but this appreciation did not significantly correlate with the two conditions.

We suggest an experiment comparing responses to a more adaptive robot to those of a less adaptive condition of the same robot could provide more substantial evidence for the relevance of this concept.

REFERENCES

1. M. Heerink, B. J. A. Kröse, B. J. Wielinga, and V. Evers, "The Influence of a Robot's Social Abilities on Acceptance by Elderly Users," Proceedings RO-MAN, Hertfordshire, 2006.
2. J. Forlizzi, DiSalvo, C. and Gemperle, F., "Assistive Robotics and an Ecology of Elders Living Independently in Their Homes," *Journal of HCI Special Issue on Human-Robot Interaction*, vol. January, 2004.
3. L. M. Camarinha-Matos and H. Afsarmanesh, "Design of a virtual community infrastructure for elderly care," *Collaborative Business Ecosystems and Virtual Enterprises, Kluwer Academic Publishers, May 2002*, 2002.
4. F. D. Davis, "Technology Acceptance Model for Empirically Testing New End-user Information Systems Theory and Results," *Unpublished Doctoral Dissertation*: MIT, 1986.

5. I. Ajzen, "The Theory of Planned Behavior," *Organizational Behavior and Human Decision Processes*, vol. 50, pp. 179-211, 1991.
6. B. H. Sheppard, J. Hartwick, and P. R. Warshaw, "The Theory of Reasoned Action: A Meta-Analysis of Past Research with Recommendations for Modifications and Future Research," *Journal of Consumer Research*, vol. 15, pp. 325-343, 1988.
7. S. Taylor and P. A. Todd, "Assessing IT Usage: The Role of Prior Experience," *MIS Quarterly*, vol. 19, pp. 561-570, 1995.
8. V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, "User Acceptance of Information Technology: Toward a Unified View," *MIS Quarterly*, vol. 27, pp. 425-478, 2003.
9. M. Heerink, B. J. A. Kröse, B. J. Wielinga, and V. Evers, "Observing conversational expressiveness of elderly users interacting with a robot and screen agent," Proceedings ICORR, Noordwijk, 2007.
10. M. Heerink, B. J. A. Kröse, B. J. Wielinga, and V. Evers, "Studying the acceptance of a robotic agent by elderly users," *International Journal of Assistive Robotics and Mechatronics*, vol. 7, 2006.