Exploring the Influence of Age, Gender, Education and Computer Experience on Robot Acceptance by Older Adults

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ABSTRACT
It is generally recognized that non perceptual factors like age, gender, education and computer experience can have a moderating effect on how perception of a technology leads to acceptance of it. In our present research we are exploring the influence of these factors on the acceptance of assistive social robots by older adults. In this short paper we discuss the results of a user study in which a movie of an elderly person using a social assistive robot was shown to older adults. The analysis of the responses give a first indication on if and how these factors relate to the perceptual processes that lead to acceptance.

Categories and Subject Descriptors
H.1.0. [**Information Interfaces And Presentation**]: Models and Principles - *General.*

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

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

1. INTRODUCTION
The project of which this study is a part features a methodology called Technology Acceptance Modeling (TAM – see [1] for an overview). It is used to establish influences on user's intention to use a certain new technology. It can predict how well a system will be accepted by a certain user group and explain differences between individuals or sub groups. In earlier research [2] we established the perceptual influences on acceptance of a robot by older adults which resulted in what we called the Almere model (see Table 1 and Figure 1). These influences are measured by using a questionnaire with a five point Likert-type scale, varying from 'totally agree' to 'totally disagree' with corresponding scores from five to one. The items that represent a certain influence form a construct and the model as shown in Figure 1 demonstrates how these constructs interrelate (see [3] for a detailed model description, including a questionnaire listing).

Many TAM models do not only show these perceptual influences. They also incorporate so called moderating factors: factors like age, experience, voluntariness and education that lay beyond the perception of the system but have an effect on the strength of the perceptual influences on acceptance [4].

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Table 1. Almere model constructs

Construct	Definition
Anxiety	Evoking anxious or emotional reactions when using the robot.
Attitude towards technology	Positive or negative feelings about the appliance of the robot.
Facilitating conditions	Objective factors in the environment that facilitate using the robot.
Intention to use	The outspoken intention to use the robot over a longer period in time.
Perceived adaptability	The perceived ability of the robot to be adaptive to the changing needs of the user.
Perceived enjoyment	Feelings of joy or pleasure associated by the user with the use of the robot.
Perceived ease of use	The degree to which the user believes that using the robot would be free of effort
Perceived sociability	The perceived ability of the robot to perform sociable behavior.
Perceived usefulness	The degree to which one believes that using the robot would enhance his or her daily activities
Social influence	The user's perception of how people who are important to him think about him using the robot
Social presence	The experience of sensing a social entity when interacting with the robot.
Trust	The belief that the robot performs with personal integrity and reliability.

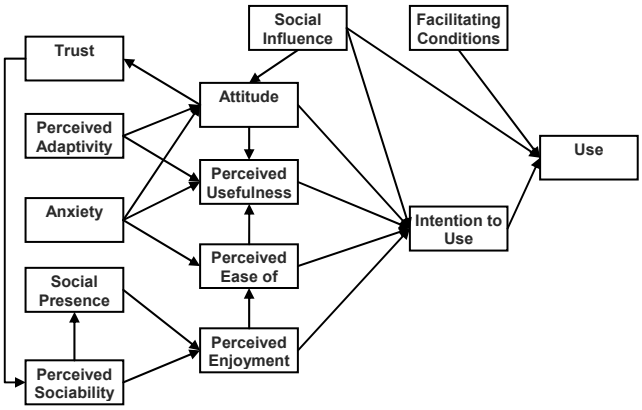

Figure 1. Almere model construct interrelations

In this paper we will explore the commonly recognized [1] moderating factors age, gender, education and computer experience and establish if they are relevant when studying acceptance of assistive social robots, used by older adults. More specifically, we want to find indications of relationships between these factors and the constructs of our model.

2. METHOD

For this exploration we designed an experiment in which we used a video of the RoboCare robot [5], which is cylinder shaped and mobile (wheels) which serves both as an interface to the 'smart home' technology and as an autonomous actor. We made Dutch spoken versions of a video in which the robot had the following functionalities: monitoring the user and alarming if necessary; helping to remember to take the right medication at the right time and functioning as a fitness advisor.

We found 66 older adults willing to participate, between 65 and 92 years old, 43 female and 23 male, partly living in eldercare homes and partly living independently. They were visited by the researcher who showed the video from a laptop.. After this, the participant would be asked to fill out the questionnaire.

3. RESULTS AND CONCLUSIONS

The questionnaire responses were processed and Crohnbach's Alpha [6] was calculated, resulting in scores above 0.7 for all constructs, which means they were found reliable. Subsequently we carried out a correlation analysis. As Table 2 shows, there were correlations between Anxiety and all three moderating factors. Apparently, Anxiety is a construct that is very sensitive to these factors. Furthermore, Age correlates with Intention to Use, indicating that older participants are less willing to use the robot than younger ones. Also we find Education correlating with Perceived Sociability, suggesting that the more education a participant received, the less open he or she is to perceive the robot as a social entity.

Table 2. Pearson correlation scores for constructs and moderating factors (* p < 0,05, ** p < 0,005)

	Age	Educ.	Exp.
ANX	,331**	-,229*	-,356**
ATT	0,182	-0,173	0,006
FC	-0,185	0,199	,260*
ITU	-,276*	-0,094	0,024
PAD	0,14	0,129	0,042
PENJ	-0,014	-0,057	0,182
PEOU	-0,16	0,117	,308**
PS	0,057	-,250*	-0,043
SI	0,09	-0,101	0,008
SP	0,206	-0,139	-0,002
TR	-0,02	0,087	0,079
PU	0,05	-0,091	0,002

Finally, there is a correlation between Experience with both Facilitating Conditions and Perceived Ease of Use. This suggests that more experienced users have a higher appreciation of the factors that facilitate using the system and perceive the system more as particularly easy to use.

To establish the influence of gender, we carried out a t-test and included not only the constructs, but also the other moderating factors. We found significant scores (see Table 3) for Experience and Perceived Ease of Use.

Table 3. Significant t-test results for gender differences

	t	Sig.
EXP	2,220*	,032
PEOU	2,777*	,007

Thus, a gender difference for both Experience and Perceived Ease of Use coincides with the correlation of Experience with Perceived Ease of Use. This indicates that male participants have more experience with computers and – as probably also more experienced female participants – they perceive the robot more as an easy to use technology.

4. DISCUSSION AND FURTHER RESEARCH

The results of this experiment show that the four moderating factors are relevant in this context. However, this experiment featured a movie that was shown from a laptop, which can hardly be assumed to be fully comparable to experiencing the use of a real robot. Moreover, we used just one very specific robot and in future research, we have to establish if these findings can be confirmed in user studies including a 'real robot experience' and different systems. Furthermore, we drew some swift conclusions, but undoubtedly much more can be said about the (implications of) established influences, especially when linked to related research. Finally, there may also be other moderating factors that can be of influence (physical condition, voluntariness, …). Future projects could focus on making a complete inventory.

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