Subjective Experience of Interacting with a Social Robot at a Danish Airport

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Introduction

This study originates from a social robot research project at Aalborg University with the aim of developing and implementing robots in a variety of contexts. This raises questions as to how social robots should behave and which variables are important when implementing a social robot in a public setting. Important variables can be elicited via user interaction and tested via scales. The study consists of two tests, one where variables are elicited and one where the scales are used to evaluate the experience of the human robot interaction (HRI).

Methods

Two tests were set up in Aalborg Airport (AAL) to investigate which variables are important for the HRI with a social robot and to develop scales based on them. Both tests were conducted on Danish travellers who interacted with a *Double* robot shown on figure 1.

- **Subject recruitment** was done by the robot which approached travellers. It presented an interface asking if it may help with wayfinding. If the traveller accepted, they were led towards their chosen destination until an experimenter stopped them. The *Double* robot was remotely controlled via a computer by a present researcher. This method was similar in both tests and was done to provide a more ecological interaction between robot and subject.
- **Test 1**: 30 subjects (8-62 yrs, M=37.9 SD=17.1) participated in a semi-structured interview about their first impressions after the interaction while observational data was gathered during the interaction.
- **Test 2**: 43 subjects (10-72 yrs, M=40.1, SD=13.4) rated their interactions on the scales using a PC after their unsolicited interaction. The robot height, direction of approach, and distance to the travellers were varied.

Figure 1. *Double*'s front and profile.

Results - Elicitation of variables

From the first test an affinity diagram was made. On of the 10 elicited categories are shown on Figure 2.

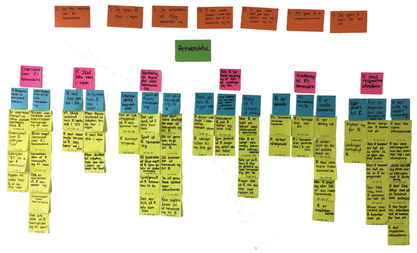

Figure 2. One example of the 10 categories from the affinity diagram This was regarding Approach.

24 variables were elicited, where 23 of them were used to evaluate the HRI and one were used as demographic information about subjects. All 24 variables were evaluated on a Visual Analogue Scale (VAS). The 23 HRI scales are shown on Figure 2.

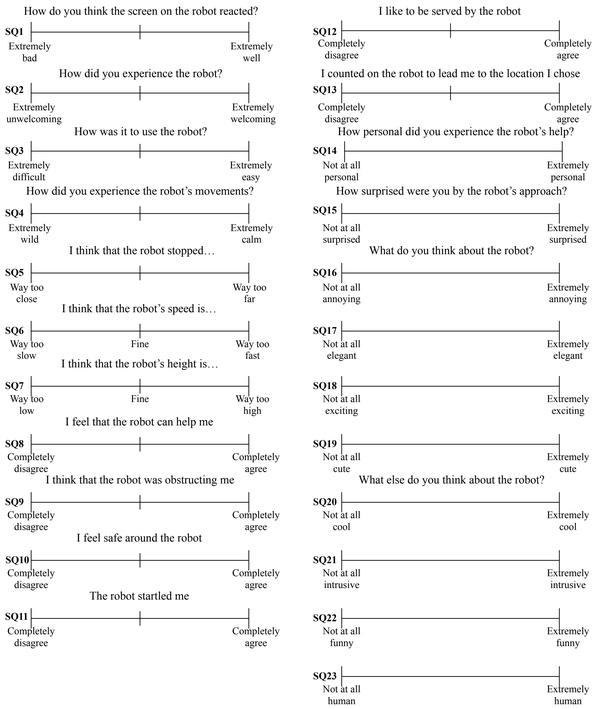

Figure 3. The 23 VAS's developed from the elicited variables.

The 24th scale question was "How fond of technology are you?" and were evaluated on a unipolar VAS with the anchor points: *Not at all fond* and *Extremely fond.*

Results - Scale Testing

A boxplot was made which shows the ratings of the 23 SQs after interacting with the robot. See Figure 4.

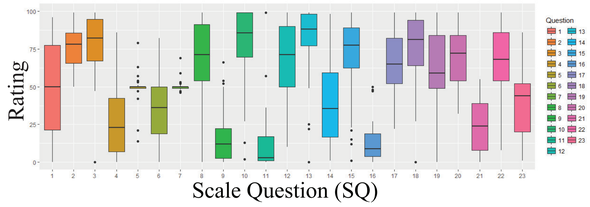

Figure 4. Boxplot with median and box ranging from 25-75 % based on the rating from answers on the 23 scales.

Results from the second test were analysed with Principal Component Analysis (PCA) with groupings relating to the robot's height, distance from subject, and direction of approach. Figure 5 shows a biplot from the PCA.

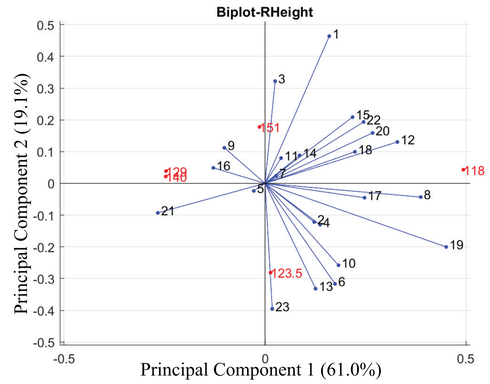

Figure 5. Biplot showing how the different variables contributes to components and which variables correlates. The black numbers denotes the SQ and the red to the different heights in cm.

From the PCA positive (pos) and negative (neg) correlations were found. This was done relating to the robot's height, distance and direction, respectively, and are as follows:

- **Height (pos):** SQ10-SQ13, SQ12-SQ18, SQ14-SQ15, SQ8-SQ17
- **Height (neg):** SQ12-SQ21, SQ18-SQ21, SQ2-SQ9, SQ4-SQ9, SQ16-SQ19
- **Distance (pos):** SQ1-SQ12, SQ7-SQ17, SQ10-SQ22, SQ8-SQ21
- **Distance (neg):** SQ2-SQ9, SQ14-SQ16, SQ10-SQ13, SQ13-SQ22, SQ5-SQ21, SQ19-SQ20
- **Direction (pos):** SQ8-SQ10, SQ9-SQ14, SQ5-SQ7
- **Direction (neg):** SQ1-SQ12, SQ9-SQ10, SQ10-SQ14, SQ6-SQ23, SQ13-SQ21

Plots comparing the correlating variables were made after checking for correlation. Figure 6 is one of these comparison and shows that when subjects like to be served by the robot they also found the robot exciting.

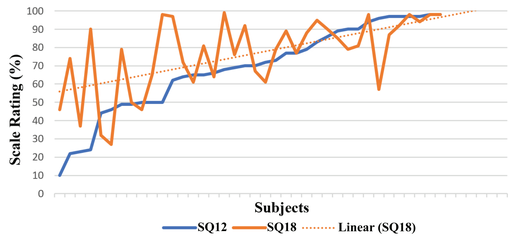

Figure 6. Comparison between ratings on SQ12 and SQ18 based on 41 subjects. Two were removed due to incomplete datasets.

Discussion

The results presented in this study probably needs further validation given they were collected on a small sample size. The affinity diagram was based on observational data from 30 people and their statements and the scales were tested on 43. Even though correlation is found it might be useful to test the reliability of the scale items. Overall the subjects who participated were very fond of technology which might have biased their scale responses. Further, the labels on SQ5 and SQ7 should be reconsidered due to the little variation in the scale responses as shown in Figure 4. Perhaps the label "Fine" is to broad and does not represent a fitting mid-point.

Key references

[1] D. Halpern and J. E. Katz. Close but not stuck: Understanding social distance in human-robot interaction through a computer mediation approach. 2013.

[2] E. Pacchierotti et al.. Human-robot embodied interaction in hallway settings: a pilot user study. 2005.

[3] K. Dautenhahn et al.. How may i serve you? A robot companion approaching a seated person in a helping context. 2006.

[4] M. M. de Graaf and S. B. Allouch. Exploring influencing variables for the acceptance of social robots. Robotics and Autonomous Systems, 2013.

[5] Y. Kim and B. Mutlu. How social distance shapes human-robot interaction. Int. J. Human-Computer Studies, 2014.