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. 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 conducted at Aalborg Airport (AAL) to investigate which variables are important for HRI for Danes and thus develop scales based on them. Both tests were conducted on Danish travellers who interacted with a *Double* robot shown on Figure 1.

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

- **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 location until an experimenter stopped them. The *Double* robot was remote controlled. 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 were 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's height, direction of approach, and distance to the travellers were varied.

Results - Elicitation of Variables

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

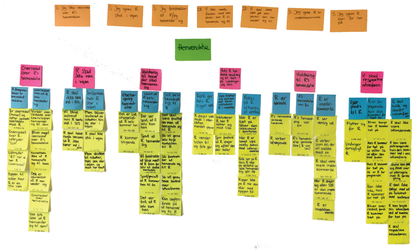

Figure 2. One example of the 10 categories from the affinity diagram regards: Approach.

24 variables were elicited, where 23 of them were used to evaluate the HRI and one was 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.

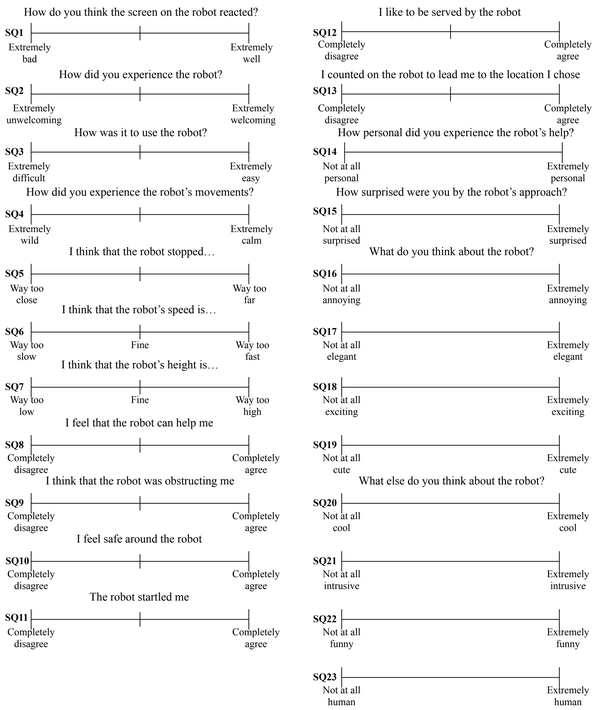

Figure 3. The 23 VAS's developed from the elicited variables.

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

Results - Scale Testing

A boxplot was made which represent the subjects' ratings of the 24 SQs after the interaction. See Figure 4.

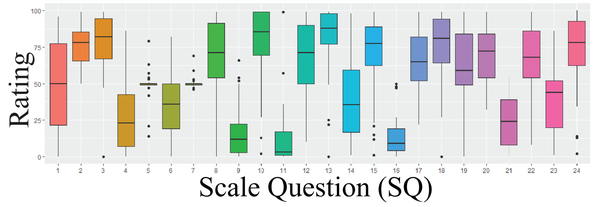

Figure 4. Boxplot with median and box ranging from 25-75 % based on the rating from answers on the 24 scales.

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.

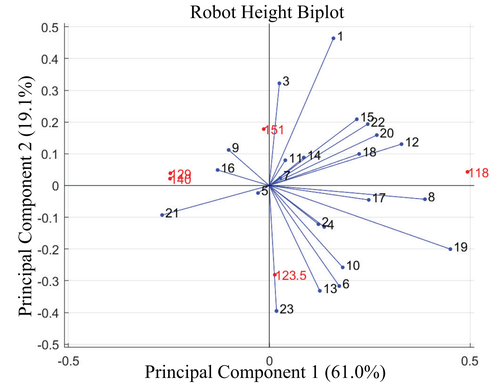

Figure 5. Biplot showing how the different variables contributes to components and which variables correlates. The black numbers denotes SQ and the red to the different heights in cm.

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.

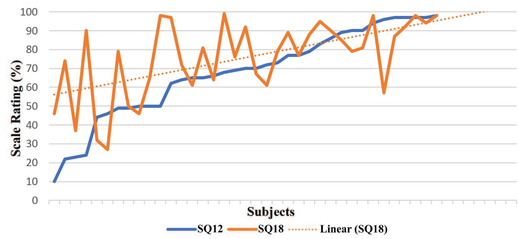

Figure 6. Comparison between ratings on SQ12 and SQ18 based on 41 subjects. Two were removed due to incomplete datasets.

Discussion

The results presented in this study probably needs further validation given that 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 small 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

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