A Template Based User-Teaching System for an Assistive Robot

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Abstract.
Demographics issues, characterised by an increasing elderly population, are expected to be a major concern both in Europe and other countries around the world. A proposed cost and care solution to these issues has been suggested that uses assistive robots in 'smart-home' environments. The deployment of such integrated facilities presents many challenges, one of which concerns the customisation of such systems to meet the needs of the elderly person themselves. One approach is to allow the elderly person to actually teach the robot sufficient behaviours that meet their care requirements. The teaching could equally well be carried out by the elderly person's relatives or carers. The overriding premise being that teaching is both intuitive and 'non-technical'. As part of a European project investigating these issues we have deployed a commercially available robot in a fully sensorised but otherwise ordinary suburban house, and designed a non-technical teaching system, based on behavioural templates, to achieve this goal. We have evaluated this integrated system within the house with 20 participants in a Human-Robot interaction experiment. Results indicate that participants overall found the interface easy to use, and felt that they would be capable of using it in a real-life situation. There were also some salient individual differences within the sample.

1 INTRODUCTION

Assistive robots in 'smart-home' environments have been suggested as a partial cost and care solution to demographics issues characterised by an increasing elderly population [10, 4]. The work described in this paper, which has been carried out in the European Framework 7 ACCOMPANY project [1], describes a *robot teaching system* designed to be used by carers, relatives and elderly persons themselves (rather than robotics experts) to provide active support in terms of *re-ablement* - defined by the Welsh Social Services Improvement Agency as "Support people 'to do' rather than 'doing to / for people' " [15] - and *co-learning* - where a person and a robot work together to achieve a particular goal. In order to research these issues we utilise a commercially available robot, the Care-O-bot3®, manufactured by Fraunhofer IPA [12] which resides in a fully sensorised but otherwise completely standard British three bedroom house near the University of Hertfordshire (we call this the *robot house*). This environment is used to test and evaluate our work in HRI. This paper describes this work and the evaluation of results from a HRI study. The main aims of this study were to assess the usability of the teaching system, however we also took the opportunity to assess participants attitudes towards having to teach a robot and also their views on the role of the robot in this context. This study was carried out in February 2014.

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2 BACKGROUND

The robot teaching system described in this paper leverages work previously carried out in the integration of the robot house sensor network, the sensory capabilities of the robot itself, and the social memory aspects from the user themselves, into a common framework. The complete system is described within what we call the 'robot house ontology' which describes both the physical and semantic nature of the system as a whole. A more detailed description of the ontology and control system approaches are described in Saunders et al., [13, 14]. However a brief description is given here.

We consider a typical care environment to be one where a person or persons remain in their own home. Our physical home ontology is modelled within a mySQL database, and all information arising from robot, house sensors and user or robot locations in the physical home causes a real-time update to the database. Episodic information, which consists of both images and sensory feedback during behaviour execution, can be accessed via GUIs allowing post-review of activities of the robot and the user (for more details see [7]). Procedural memory, which is here defined as the robot actions together with rules invoking such actions held as pre and post behavioural conditions, are also held as tables in the database. The rules themselves are encoded as SQL statements, generated by the behaviour teaching system, and refer back to the semantic information created by the sensor system.

The robot house consists of physical sensors and user and robot locations. There are over 50 low level sensors ranging from electrical (fridge door open, microwave on etc.), to furniture (cupboard door and drawers open etc.), to services (such as toilet flushing, taps running etc.) and pressure devices (sofa or bed occupied). Sensory information from the robot is sent in real-time to the database. User locations are obtained via ceiling mounted cameras [8], and robot locations via ROS navigation [11]. House locations are labelled and encoded as map co-ordinates in the database and organised hierarchically, for example, sofa location is part of the living room which is part of the 'robot house'. Each sensor also has ancillary information concerning how it should be interpreted, for example, a bathroom tap sensor value is interpreted as a moving average of values, whereas a light switch is simply a boolean on or off.

'Abstract' sensors are used to define or infer knowledge about the house or activities within the house at a higher semantic level. We define two classes of abstract sensors. The first we call *context* sensors and the second *predicate* sensors.

Context sensors are updated via a rule based context analysis system derived from HRI experiments [3]. This provides contextual information such as, e.g. 'User Preparing Evening Meal'. Thus the sensor 'User Preparing Evening Meal' would be set 'on' if a given set of propositions were true (for example, fridge has been opened recently, it is after 4pm, kitchen light is on etc.) and set off otherwise.

Taught Behaviours - Set 1

Whenever you open the microwave oven, make the robot come to the kitchen and wait outside.
If the TV is on, and you are sitting on the sofa, make the robot join you at the sofa.
If the doorbell rings and the TV is on, make the robot say"There's someone at the door" and then go to the Hallway.

Taught Behaviours - Set 2

Make the robot come to the table and remind you to always call your friend "Mary" on Thursday at 2pm.
On Mondays, Wednesdays and Fridays make the robot stand in the hall and remind you that your lunch is being delivered at 12:30pm.
If you are sitting on the sofa for more than 30 minutes, make the robot come to the sofa and tell you to take some exercise. Make the robot do this again after another 30m if you are still sitting there.
Make the robot come to the table and remind you to take your medicine at 12pm and 4pm every day, yellow pills at 12, pink pills at 4pm.

Taught Behaviours - Set 3

Make the robot come to the sofa and tell you to 'move about a bit', if, in the afternoon , you have sat on the sofa for longer than 1 hour continuously
If it is after 9pm, and you have left the sofa for over 5 minutes and the TV in on, make the robot go to the hall entrance and say "turn off the TV".
If the microwave has been open or on for more than 1 minute, make the robot come to the table and tell you that the microwave is open or on. Make the robot remind you every minute until the microwave is turned off and door is closed.

Table 1. Taught Robot behaviours. The sets increase in behavioural complexity. Participants select one behaviour to teach from each set.

How would you like to interact with robots in the future? *I would like to interact with them as a...*	Pre-test
What was the robot like in this study? *It was like interacting with a...*	Post-test
Item	*Dimension*
Friend	Equality
Servant	Control
Pet	Pet-like
Colleague	Equality
Tool	Control

Table 2. Social Expectations and Perception of the Robot Questionnaire Items

Predicate sensors are used to cope with on-going events in the house which are not reflected by the physical environmental sensors (somewhat similar to that described by Henderson and Shilcrat [6]). For example, a sensor with the label 'User has been reminded to turn off the TV' might be set if the robot has given such a reminder to the user and would typically be used to ensure that the reminder was not repeated.

Note that we label both types of abstract sensor as 'sensors', however we appreciate that this does not strictly adhere to the concept of a sensor (e.g. a device that responds to an impulse and transmits a resulting impulse), but is rather a logical condition. However, by containing such conditions as 'sensors' we are able to apply filters (and especially temporal filters) to these conditions in exactly the same way as we would do for physical sensors. For example, given the TV reminder above, we could ask 'how long ago did we remind the user to turn off the TV?' which would be technically equivalent to asking with a physical sensor 'How long has the fridge been open?'.

For this work we use the Care-O-bot3®robot [12] which uses ROS navigation (a form of SLAM) [11]) using its laser range-finders to update a map of the house in real-time and can navigate to any given location whilst avoiding obstacles and replanning routes. Similarly the robot is equipped with facilities for manipulating the arm, torso, 'eyes', robot LED's, tray and has a voice synthesiser to express given text. High level commands are sent via the ROS 'script server' mechanism and interpreted into low level commands by the robot software. Typical commands would be for example, 'raise tray', 'nod', 'look forward', 'move to location x', 'grab object on tray', 'put object x at location y', 'say hello' etc.

3 TEACHING INTERFACE

Activities within the house, at both a physical and abstract sensory level, can be joined as propositions (held as rules or preconditions) for resulting robot behaviours. Mechanisms to apply temporal constraints are also available together with a facility to invoke actions on the robot.

In order to create behaviours the user as a minimum would need to specify *what needs to happen* (the actions of the robot) and *when those actions should take place* (setting pre-conditions based on the values of physical or abstract sensors). We provide two levels of interface (in addition to direct programming of behaviours in high-level languages by robotic experts). The first allows direct entry of behaviours by specifying rules explicitly based on sensor values and choosing actions on the robot including the setting of post-conditions via predicate sensors. Hierarchical scaffolding of behaviours is also possible by choosing existing behaviours as actions. We envisage that this facility would be used by 'technical' persons generating sets of behaviours for the first time. However, creating behaviours in this way is very similar to high-level programming in that a very logical and structured approach to behaviour creation is necessary.

In order to ease these issues for persons using the robot who do not necessarily want or have such skills a second facility was created which takes away much of the complexity of the former by automatically generating many of the sub-behaviours required to operationalise the system via templates. The cost of this simplification is a loss of generality; however it is compensated for by ease of use.

To illustrate this idea an example of one such template is shown below. In this example the user wants to be reminded to take their medicine at 5pm. If we were to create this behaviour using the technical interface we would need to associate each precondition with the appropriate sensor, including the predicate sensors and create two behaviours, one to carry out the task and one to reset conditions, as follows:

1. The first behaviour would need to check that the time was after 5pm and that the user had not been already reminded i.e. a 'user

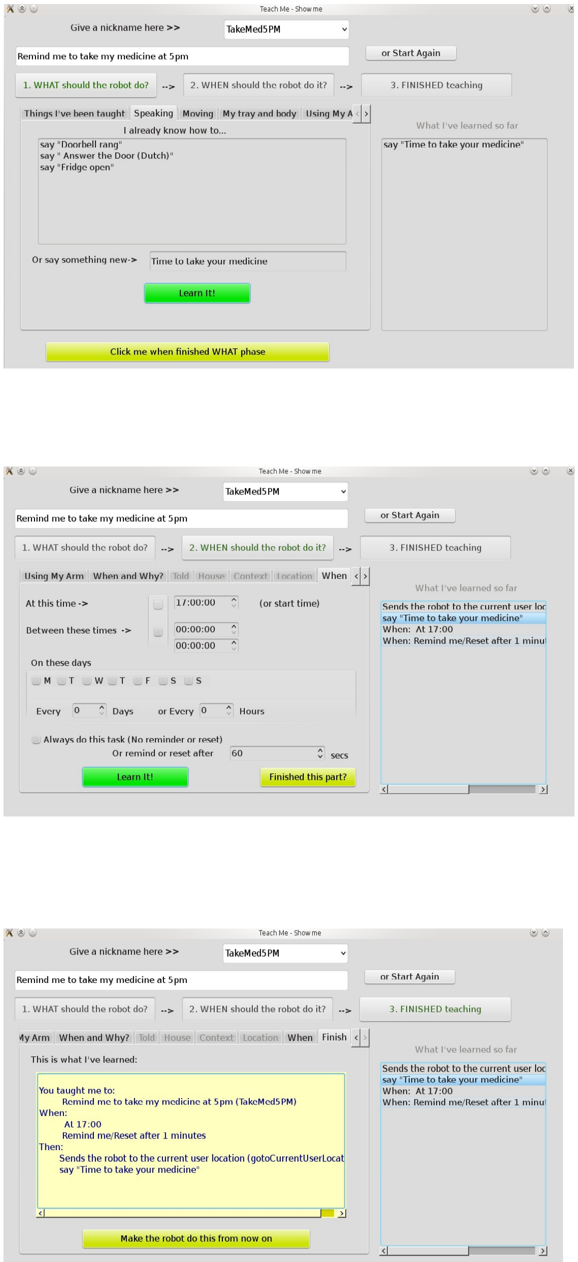

Figure 1. Shown are screenshots of the teaching interface. In the top figure the user has entered the words that the robot is to say. The middle figure shows the diary screen where in this case the condition 'after 5pm' is entered. The bottom screen shows the final behaviour created (in fact this may generate multiple behaviours on the robot execution system).

not yet reminded' predicate sensor would be true. If both of these conditions are true then the robot carries out a procedure of moving the robot to the user and saying 'It's time for your medicine' then re-setting the predicate sensor to false to indicate that the user has been reminded.

2. At some point later, a second behaviour would need to be created, which in this example would be: if after midnight, reset the 'user not yet reminded' sensor to true so that it can fire the next day.

Thus two behaviours need to be created, and careful alignment of reminder rules need to be inserted.

However, the majority of behaviours (see table 1) that we envisage users setting up themselves tend to follow a set of common templates e.g. diary like functions, or direct actions based on sensory conditions in the house. We can therefore exploit these templates to generate the appropriate conditional logic. The template in the example above is based on 'diary' like conditions and the automatic setting and creation of support behaviours (such as the resetting behaviour above). In this manner much of the cognitive load is removed from the user and left to the behaviour generation system. Co-learning is operationalized by allowing the robot to provide details of its existing sets of skills that can then be exploited by the user. Re-ablement is supported simply in the act of teaching the robot.

The standard template for 'diary like' robot actions is as follows:

Create the following abstract sensors:

```
Entered by user via GUI:

  reminderTime = t (e.g. 5pm)
  textItem e.g. 'Have you taken your medicine?'
  repeatAfter = n (e.g. 60 seconds)
  <other robot actions> e.g. "Move to user"

Created automically:

  Cond-Reminder = TRUE
  Cond-Remind-again = FALSE
```

Then create the following robot behaviours automatically:

```
1) ReminderX-reset: % resets conditions

    IF NOW between midnight and t
    AND
    Cond-Reminder = FALSE
      SET Cond-Reminder = TRUE
      SET Cond-Remind-again = FALSE

2) ReminderX:   % the actual diary reminded

   IF NOW >= t
   AND
   Cond-Reminder = TRUE
     EXECUTE <other robot actions>
     SAY <text item>
     SET Cond-Reminder = FALSE
     SET Cond-Remind-again = TRUE
```

An example of the user teaching GUI is shown in figure 1 (note: only 3 screenshots are shown) and displays the actions a non-technical person would use to create the example behaviour above. The steps consists of 'what' the robot should do followed by 'when' the robot should do it. Steps are as follows: the user chooses to send the robot to the current user location and then presses a 'learn it' button . This puts the command into the robot memory. Then the user makes the robot say 'It's time for your medicine'. This is not in the robot's current set of skills and so is entered as a text input by the user (screenshot shown at top of figure 1). This is followed by a press of the 'learn it' button. Now the two actions are in the robot's memory and the user completes the 'what' phase and starts on the 'when' phase. The user is offered a number of choices including reacting to events in the house, or user or robot locations or a diary function. The user chooses a diary function and enters 17:00 in the 'at this time' box (screenshot shown in middle of figure 1). Again this is followed by pressing the 'learn it' button. Having completed both 'what' and 'when' phases the user is shown the complete behaviour for review and can modify it if necessary (screenshot shown at bottom of figure 1). Once happy the user presses a 'make me do this from now on' button and the complete behaviour becomes part of the robot behavioural repertoire.

4 EVALUATION

Evaluation of the template based teaching system was carried out in late February 2014 in the robot house. This involved 20 participants recruited from the general population.

4.1 Procedure

Each participant was introduced to the experimenter, a technician and the experiment psychologist. The technician was present only to ensure the safety of the participant (this is a safety requirement of the ethics agreement) and played no other part in the experiment. The technician was also stationed in a part of the room outside the main interaction area.

The psychologist asked the participant to fill in a consent form, and demographic, computer, robot experience and the Ten Item Personality Inventory(TIPI) [5] and a questionnaire developed to measure social expectations towards robots, which is described table 2 along with its dimensions. This latter questionnaire is used to investigate social expectations of robots along three dimensions.The first dimension, *Equality*, is comprised of the items 'Friend' and 'Colleague'. High scores on this would suggest that the participant would expect the robot to act in manner suggesting an equal(social) footing to themselves within interactions, whilst a low score would suggest the opposite (i.e. that the robot adopts a more deferential role). The second dimension, *Control*, is comprised of the items Servant and Tool. High scores along this dimensions suggest that the user would expect that the interaction with the robot is one in which the user will exert a high degree of control, while a lower score would suggest that the robot is expected to act in a more autonomous manner. The third dimension measured using the questionnaire is that of the *Pet* dimension which suggest an expectation that the robot should be like a pet within the interaction. Please refer to [9] for a more detailed discussion about these items.

A second version of this questionnaire was given to participants after the interaction, in order to examine their social perception of the robot.

The experimenter then took over and the psychologist retired to a different room. The experimenter then explained the purpose of the experiment, the nature of the sensorised house and the capabilities of the robot (in this experiment the robot capabilities were restricted to moving to differing locations and speaking, although the tray and arm/gripper were visible).

The robot had previously been taught to approach the experimenter and participant and to introduce itself by saying "welcome to the robot house". This gave the experimenter a chance to explain the robot capabilities and for the participant to see the robot in action for the first time.

Examples of three sets of behaviours, each with increasing complexity, was shown to participants (the behaviours are shown in table 1). The behaviour relating to 'answering the doorbell' in set 1 was used by the experimenter to show the participant how to use the teaching GUI.

Participants were then asked to choose one behaviour from each set of behaviours and use the teaching GUI to teach the robot these behaviours.

During the teaching process the experimenter stayed with the participant and helped them when asked. Given that none of the participants had ever interacted with a robot before, and that the teaching GUI was entirely new to them, we felt that this was a necessary requirement. Furthermore, part of the post experimental questionnaire asked them to indicate whether they thought they could continue to use the teaching system without the help of the experimenter. The participant's use of the teaching system was also videoed for later analysis.

Having taught the robot the new behaviour the experimenter then invited the participant to test it. If the behaviour operated succesfully then the participant moved on to teaching the next behaviour in the subsequent set. Alternatively they could modify the existing behaviour and re-test. Having taught all three behaviours (one from each set) the experimenter retired to another room and the psychologist returned and asked the participant to fill in a post evaluation questionnaire based on Brooke's usability scale [2] (see table 3). A subsequent questionnaire (see table 8) was also completed which focused on the usefulness of the robot and teaching system specifically. We felt that this separation of duties between the experimenter and psychologist was necessary to avoid putting any pressure on the participant when they were completing the evaluation questionnaire.

After completion of the questionaire the participant was invited to ask questions if they wished about the experience, the house the robot etc. In fact, all of the participants were very interested to see how the house and robot worked.

Modified Brooke's Usability Scale
I think that I would like to use the robot teaching system like this often.
I found using the robot teaching system too complex.
I thought the robot teaching system was easy to use.
I thought the robot teaching system was easy to use
I think that I would need the support of a technical person who is always nearby to be able to use this robot teaching system .
I found the various functions in the robot teaching system were well integrated.
I thought there was too much inconsistency in the robot teaching system.
I would imagine that most people would very quickly learn to use the robot teaching system.
I found the robot teaching system very cumbersome to use.
I felt very confident using the robot teaching system.
I needed to learn a lot of things before I could get going with the robot teaching system .

Table 3. The table shows the questions posed to participants specifically relating to usability. All answers were based on a 5-point Likert scale

5 Results

5.1 Demographics

There were 20 participants in the study, 16 female and 4 male. The mean age in the sample was 44 years (SE=15.3), with a median age of 49 years. The computer usage of the participants can be found in Table 4, which suggest that majority of participants used computers for work/studies as well as for social reasons. There was a split in the sample however, in that about half of the participants used computers for recreational reasons, such as games. None of the participants programmed computers. The mean number of hours spent on computers in the sample was 35 hours (SE=2.98) with a median number of hours of 33. Only one of the participant had had any experience with robots of any sort. Table 5 shows the responses to the TIPI in the sample. Table 6 show the responses to the Social Role questionnaires which indicate that participants initial expectations of the social roles of robots did not differ significantly from their perception of the robot within the actual interaction.

Activity	Yes	No
Work or Study	18	2
Socialising	19	1
Recreation	8	12
Programming	0	20

Table 4. Computer Usage in the Sample

	Mean	SD
Extraversion	4.38	1.48
Agreeable	5.35	1.14
Conscientious	5.83	1.15
Emotional Stability	4.85	1.36
Openness	5.17	1.10

Table 5. Personality in the Sample

Role	Stage	Mean	SE	Diff	95% CI	t(19)
Equal	Expect	3.1	0.21	0.22	-0.35 – 0.8	0.82
	Actual	2.88	0.24			
Control	Expect	3.7	0.17	0.18	-0.29 – 0.64	0.79
	Actual	3.52	0.18			
Pet	Expect	2.35	0.25	0.21	-0.54 – 0.96	0.59
	Actual	2.21	0.22			

Table 6. Initial Social Expectations and Actual Social Perception

6 Responses to the SUS

The mean participant response to the the System Usability Scale regarding the teaching interface was 79.75 (SE=2.29), and the median response was 76.25. These scored were significantly higher than the "neutral score" of 50 ($t(19) = 12.97, p < .01$).

A multiple regression analysis was conducted in order to investigate demographic predictors of SUS responses to this task. After removing non-significant predictors, the final model had an adjusted r^2 of .28, and predicted SUS scores significantly ($F(2, 17) = 4.70, p < .05$). The model is described in Table 7 and suggests that both age and scores on the Conscientiousness personality trait were associated with lower scores on the SUS for this task.

7 Responses to Ad-Hoc Questions

Participant responses to the ad-hoc Likert items can be found in table 8. All participant responded '*Very Useful*' or '*Useful*' when asked if they thought it useful useful to teach a robot. In addition all participants answered '*Definitely Yes*' or '*Yes*' when asked if they thought that they would be able to teach the robot, if they would do so for a relative, and that they would find it useful to customise the tasks of a robot beyond a set of standard tasks. The participants did not, however, agree as strongly on whether or not the robot should be completely set up by someone else, with a wider range of responses

Predictor	β	SE	t(19)	p
Intercept	0.00	0.00	0.00	1.00
Age	-.49	.20	-2.48	$< .05$
Conscientiousness	-.40	.20	-2.23	$< .05$

Table 7. Predictors of SUS Scores

from the participants.

Participants also responded that they were overall '*Very Comfortable*' or '*Comfortable*' with a robot informing them that there was a problem in their house, and 17 out of the 20 participants answered that they were at least '*Comfortable*' with the robot informing a third party about an unresolved problem, but there was less agreement regarding having a robot suggest that they play a game or exercise.

Do you think it is useful teach a robot?					
Very Usef.	Usef.	Neither	Not Usef.	Not at all	Median
18	2	0	0	0	1.00
Do you think that *you* would be able to teach the robot?					
Def. Yes	Yes	Neither	No	Def. No	Median
10	10	0	0	0	1.50
Would you be willing to teach the robot for someone else e.g. if you were a relative or carer of the other person?					
Def. Yes	Yes	Neither	No	Def. No	Median
14	6	0	0	0	1.00
Do you think that robot should already have been completely setup by someone else?					
Def. Yes	Yes	Neither	No	Def. No	Median
1	3	4	11	1	4.00
Do you think that the robot should be able to carry out standard tasks but it would be useful to be able to customize it?					
Def. Yes	Yes	Neither	No	Def. No	Median
13	7	0	0	0	1.00
Is it useful knowing what the robot can already do?					
Def. Yes	Yes	Neither	No	Def. No	Median
12	8	0	0	0	1.00
How would you feel about having a robot suggesting that you take more exercise?					
V. Comf.	Comf.	Neutral	Uncomf.	V. Uncomf	Median
9	8	2	1	0	2.00
How would you feel about having a robot suggesting that you play a game together e.g. a video game or chess/draughts?					
V. Comf.	Comf.	Neutral	Uncomf.	V. Uncomf	Median
6	11	2	1	0	2.00
How would you feel about having a robot warning you that there was a problem in the house e.g. fridge left open hot/cold taps running or TV left on?					
V. Comf.	Comf.	Neutral	Uncomf.	V. Uncomf	Median
18	2	0	0	0	1.00
How would you feel about having a robot informing someone else that there was a problem in the house e.g. by texting them, if the problem had not been resolved?					
V. Comf.	Comf.	Neutral	Uncomf.	V. Uncomf	Median
12	5	2	1	0	1.00

Table 8. Frequencies of responses to the ad-hoc Likert Items

As these were ordinal Likert-items, linear regression analyses were not performed as for the SUS scores. Instead a series of exploratory Spearman's correlations were performed to investigate relationships between the items that there were disagreements regarding in the sample, and the measures described in the demographics section.

For wanting the robot already set up, there was a significant correlation between this and the *Equality* dimension of the initial social expectations ($\rho(20) = .70, p < .01$), and a correlation approaching significant between this and the *Emotional Stability* personality trait ($\rho(20) = .40, p = .08$). Both of these correlations indicated that participants with higher scores along these dimension were less likely to want the robot fully set up by someone else. There was also a trend approaching significance for this item and *Age* ($\rho(20) = -.37, p = .10$), in which older participants were more likely to want the robot already set-up.

There were no significant relationships between comfort with the robot suggesting that one take more exercise and the demographic measures, but there was a trend approaching significance for the *Control* dimension of the Actual Social Role Perception of the robot ($\rho(20) = .40, p = .07$). This trend suggested that participants who rated their interaction with the robot highly along this dimension were less comfortable about the robot making such suggestions.

There was a significant relationship between the *Equality* dimension of the initial social expectations and Comfort with a robot suggesting that one play a game with it ($\rho(20) = -.69, p < .01$), suggesting that participants that scored highly on this dimension were more comfortable with the robot making such suggestions.

There was a significant relationship between *Age* and Comfort regarding the robot contacting a third party in case of a problem ($\rho(20) = -.53, p < .05$), where older participants were more comfortable with this.

8 DISCUSSION

8.1 Summary of Results

The results from the SUS suggest that participants found the interface easy to use. Moreover, all participants indicated that they felt able to use a system like this to teach the robot, and willing to use such a system to set-up behaviours for an elderly relative or person in their care. These are encouraging results which suggest that further development of the robot teaching system is warranted.

In terms of individual differences, there are some salient relationships. The relationship between *Age* and SUS scores are not unexpected. The older members of the sample found the system more difficult to use than the younger participants. Related to this is the impact of age on the ad-hoc item regarding wanting the robot to be already set up by someone else. Here, older participants were more likely to want the robot being fully set-up than younger participants.

Taken together, this suggest that the current stage of this teaching system may be better suited for use by carers and relatives of elderly people to set up the robot's behaviours for them, but that it needs to be further developed in order to be more suitable for the use of elderly people themselves.

The relationship between items covering the possibility of the robot contacting third-parties in case of problems, and *Age* is also interesting (and we envisaged that this would be a key item that may be taught to the robot). While one explanation for this result may be that older participants were closer to having to consider these scenarios in their own lives than their younger counterparts, a more likely explanation may be that the older portion of the sample were more likely to have had more experiences with caring for elderly parents or other relatives and so might identify more strongly with the third party that is to be contacted. Some of the informal responses from participants during the debrief of the study did reference such experiences.

The items related to the robot making suggestions as to what its owner should engage in (such as exercise or playing games, which again could be a likely candidate for teaching to the robot), seemed to be more related to the participants' expectations and perceptions of the social roles of the robot. Participant scoring highly in the Equality dimension for expected social roles, were more likely to want the robot to suggest games. This is in line with the findings reported in [9], which suggest that high scores on this dimension are related to a preference for interactions with robots that are game-like (i.e informally collaborative and/or competitive as well as intrinsically rewarding) in nature. This may also explain the relationship between this dimension and wanting the robot completely set-up. Participants scoring high along this dimension may have found the thought of setting up behaviours with the robot to be a more pleasurable activity than participants who scored lower along this dimension.

The relationship between the Control dimension of the participants' perception of the robots' social role within the actual interaction suggest that participants who saw the robot as having less autonomy and being more controllable by its user were less likely to want the robot to engage in persuading its user to engage in healthy behaviours.

9 CONCLUSION

We have a briefly described a robot teaching system designed to be used by persons operating in assistive enviroments in smart homes, typically carers, relatives or the person themselves. The teaching component exploits sets of standard templates in order to generate robot behaviours. This approach avoids the complexity of robot behaviour generation for a large set of tasks which we believe would be required by such persons, however more complex tasks would still need technical personnel involvement. The teaching interface was evaluated with end users in February 2014 and indicated that participants considered that such a system would be both useful and useable by them for aiding persons to stay in their homes for longer periods. Our future work includes deriving contextual rules automatically for the robot based on a person's activities in the house. For example, the robot would learn that it should always be present near the kitchen when breakfast was being prepared. This type of activity would compliment the direct *teaching* described in this paper with a *learning* mechanism.

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