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Abstract. Recent years have seen a development of social robots in all kinds of different roles. For social robots to be tailored to the needs of the user and become more accepted, we need to understand how people perceive and interact with robots in these different roles. This study investigates people's attitudes toward robots in two different roles (utilitarian: practically oriented vs hedonic: socially oriented) after interacting with them at home for several days. Results show that people's attitudes towards the same robot differ between the roles that were applied to the robot. People also described their interactions with the robot in different terms depending on its role. Implications of these findings are discussed in light of tailored approaches in the design of interactions between humans and social robots.

Keywords: Attitude change · Tailored HRI · Roles of social robots

1 Introduction

Social robots embody aspects of all three canonical categories of humans, animals and artifacts (i.e., objects made by humans, e.g., tools), and they cannot merely be placed within one of those categories [15]. People will see social robots as a new ontological category in addition to humans, animals and artifacts. This indicates that a social robot can have different roles, in which more human- or animal-like interactions and conceptualizations overlap more with the social aspects of the robot and the more artifact-like interactions and conceptualizations more with the practical aspects.

This is in line with the distinction between utilitarian and hedonic product aspects within the field of human-computer interaction [11,12]. Utilitarian aspects are much more practical, providing instrumental value to the user. This implies that there is an objective external to the interaction with the product, such as increasing task performance. Hedonic aspects do not focus on such external objectives. Instead, the mere interaction with the hedonic product aspects can be considered an end in itself, providing self-fulfilling value to the user.

Based on this, a social robot can be perceived as a utilitarian system - focusing on the tasks that it can perform – or a hedonic system - focusing on the opportunity for social interaction and relationship building [5]. [3] makes a similar distinction, dividing the role of a robot into machines or tools on one end, and assistants, companions and partners on the other end.

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[5] found that utilitarian aspects are crucial in determining whether people use a social robot or not, but once they do choose to use the robot, the hedonic social interactions seem to become much more important. [24] found a similar importance of hedonic social interactions. When studying a vacuum robot, they found that some – but not all – users named it, played with it, gave it a personality and gender, in addition to using it for its intended purpose of cleaning. This shows that people can assign different roles to a robot in their home. Indeed, earlier research suggested that the role a robot uses influences the robot's effectiveness [23]. That is, when a robot used an evaluative role (as compared to a non-evaluative role), it was more effective in stimulating learning behavior of its user [23]. Moreover, [24] found that social activities led to a significantly higher satisfaction with the robot. Furthermore, a social robot with low social interaction skills is evaluated more negatively in terms of sociability and competence compared to a robot with high social interaction skills [14]. This suggests that the perceived social aspects of a robot could lead to a more positive evaluation of the robot.

In contrast, some studies have shown that a robot in a utilitarian role is preferred over a robot in a social role. Indeed, the idea of having an electronic assistant that makes life easier by carrying out tasks for you might be very appealing to most people [13]. The utility of a robot (e.g., usefulness and ease of use) has been shown to be an important factor in people's acceptance of that robot [4,7]. Furthermore, [8] found the social impact of functional robots to be overestimated. The social activities with the robot that the participants engaged with - such as talking and playing with it - wore off when people became familiar with the robot, possibly due to a novelty effect. Moreover, [10] found that social and companionship possibilities of domestic robots were not appreciated and evaluated negatively.

1.1 Types of Attitudes Towards Social Robots

Based on these findings, we argue that people's evaluations of a robot might depend on the role of the robot. Such evaluations are captured in people's attitude. Rooted in the work of Allport [1], an attitude is now often defined as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" [6, p. 1]. Attitudes can be divided into affective, behavioral, and cognitive levels [20]. Regarding a social robot, a person's affective attitude reflects their feelings or emotions toward the robot, their behavioral attitude reflects their observable behavior toward the robot, and their cognitive attitude reflects their thoughts about the robot.

The distinction between affective, behavioral, and cognitive attitude is not always explicitly made or made between all three components. However, this distinction is useful as it can provide a more in-depth view of a person's attitude. For example, people might believe a social robot to be worthwhile (positive cognitive attitude), while feeling uneasy when interacting with the robot (negative affective attitude). Furthermore, it can potentially account for some of the mixed findings identified in previous research [18].

While previous work does indicate an influence of the role of a robot on people's attitude toward that robot, no previous research has yet been found that empirically compares attitudes across different roles of the same robot. As described before, a social robot can have a utilitarian or hedonic role, but the impact of those roles on how people evaluate that robot is still unclear.

[16] did look at differences in attitude across utilitarian and hedonic robots, but they used two different types of robots (the zoomorphic Pleo robot and the Roomba vacuum robot). They found a higher enjoyment with the hedonic robot, while the utilitarian robot was perceived more useful and easier to use.

1.2 Research Aims

In this study our aim was to investigate to what extent people's attitudes towards a social robot would change between a utilitarian and a hedonic role. This role was manipulated solely by changing the description of the robot. The attitudes that people had towards the robot were measured on three levels: affective, behavioral, and cognitive. Based on earlier work on people's evaluations of utilitarian aspects of robots [5,7,8,13], we expected that overall, people's attitudes towards the utilitarian robot would be more positive than those towards the hedonic robot.

2 Method

2.1 Participants and Design

The sample size was mainly determined by more practical restrictions; there were five robots available with four weeks of data collection, enabling the experiment to be conducted with 20 participants in total (five participants per week). A total of 20 participants (3 males, 16 females, 1 unknown; age $M = 23.35$, $SD = 1.790$, Range = 20 to 28) participated in a field experiment about attitudes towards social robots. The experiment had two conditions: utilitarian vs hedonic role. Attitudes toward the robot (divided into three levels: affective, behavioral, and cognitive) were the dependent variables. All participants used the robot in both a utilitarian role and a hedonic role (order was counterbalanced). In both conditions, attitudes were measured through an online survey, behavior statistics and qualitative interviews.

2.2 Materials

The robot used in this experiment is the Anki Vector robot, which is a small programmable robot. Vector is made to explore and react to its surroundings. The Vector robot has a variety of sensors, including a camera, touch sensors, an accelerometer and several microphones. In order to initiate an interaction with Vector, the user must say "hey Vector". The robot will indicate that it is listening, after which the desired command can be given. If no command is

given, Vector automatically reverts back to exploring its environment. Vector can communicate with vocal sounds and lights, as well as through expressions with its eyes and movements with its arm. If the robot is low on battery, it will go to its charger automatically.

In order to manipulate the role of the robot, participants were given an information sheet about each of the two robots. In the information sheets, first some basic information about the robot is explained. This includes information about the Wi-Fi, the cube, the button on the robot, the meaning of different lights on the robot, volume settings and charging. This information was provided in both conditions. The second part of the sheet differed between the two conditions. In the utilitarian condition, it contained elements such as setting a timer, asking the weather, unit conversions, general knowledge questions. In the hedonic condition, elements such as playing a game, dancing, and fist-bumping were included. The number of items between the two types of information sheets were similar. The conditions were counterbalanced, and the order of the conditions was assigned randomly.

Since the exact same robot was going to be used in both conditions, it was important to make people believe these were different. Therefore, the robot for the second condition was introduced as a new robot with a different eye color and differently colored tracks. Furthermore, the robot was taken back at the end of the first condition, then the participants had a rest day and after that the second robot was introduced.

2.3 Measurements

People's attitudes toward the Vector robot were measured on three levels: affective, behavioral, and cognitive. Affective attitude was measured through the Negative Attitudes toward Robots Scale (NARS) [19]. The scale was adapted to be applicable to the Vector robot. This scale had 14 items that were rated on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Answers to the 14 questions were summed into an Affective Attitude score ($\alpha = 0.66$). As this scale measures negative attitudes, the lower the score, the more positive the participant's affective attitude towards the robot was.

Behavioral attitude was measured through behavioral statistics that were automatically collected with the robot. They include the number of wakewords ("hey vector"), the total distance driven (in cm) and the number of utilities used.

Cognitive attitude was measured through the Robot Attitude Scale (RAS) [2]. This scale is a semantic differential scale with 11 items that were rated on an 8-point scale. Answers to the 14 questions were summed into a Cognitive Attitude score ($\alpha = 0.78$). As this scale measures negative attitudes, the lower the score, the more positive the participant's Cognitive Attitude towards the robot was.

Due to the low number of participants, we decided to also include qualitative data to be able to shed more light on the quantitative results. A short semi-structured interview was conducted at the end of the experiment to gain more meaningful insights. During this interview, the participants were asked about their experiences with Vector, how they used the robot (e.g., placement, frequency, duration), and their experiences with the different conditions.

2.4 Procedure

Before the experiment started, participants read an information sheet and gave consent for participating in this study. Then, the robot was introduced together with an information sheet (for either the utilitarian or hedonic condition), participants completed the first attitude measurement, and they were told that they could use the robot freely for the next two days. After these two days, the experimenter picked up the robot and the attitude measurements were conducted again. After one day without the robot, the experimenter went back to introduce the second robot, as well as the second information sheet. Again the attitude measures were performed, participants used the robot for two days, and the robot was retrieved again. The behavior statistics were taken from the robot upon retrieval after each of the two conditions. During the retrieval, participants completed the final attitude measures and were interviewed about their experiences. Finally, participants were thanked for their participation, debriefed about the main goal of the experiment, and compensated with €20.

3 Results

Due to violations of normality, data on the behavioral measures were transformed by taking the square root of the raw data. After transformation, assumptions of normality were met for all transformed variables, except for the number of utilities used in the utilitarian condition. As this was only a very slight violation (Shapiro-Wilk test: $p = .052$, Skewness-Kurtosis test: $p = .049$) and all other behavioral statistics variables passed this test, analyses were performed on the transformed data.

3.1 Affective Attitude

A significant main effect of the role of the robot on Affective Attitude toward that robot was found, $F(1,19) = 8.10$, $p = .010$, $\eta^2_{\text{partial}} = .30$. Participants' affective attitude was more negative towards the utilitarian robot ($M = 35.50$, $SD = 6.27$) compared to the hedonic robot ($M = 33.65$, $SD = 4.92$).

The outcomes of the statistical analyses showed a more negative Affective Attitude in the utilitarian condition compared to the hedonic condition. As participants perceived the robot in the hedonic role much more as a social being compared to the robot in the utilitarian role, this gave rise to feelings of pride (e.g., when the robot correctly executed a command), guilt (e.g., when turning

the robot off), loss (after the robot was retrieved from their home) or companionship (e.g., having something to come home to). These feelings indicate that participants formed a bond/attachment to the robot, which might explain their preference for the hedonic role over the robot in the utilitarian role to which they did not feel strongly attached.

3.2 Behavioral Attitude

The wakeword and distance statistics are an indication of the frequency/duration of use of the robot. Neither the number of wakewords used ($t(18) = -0.93$, $p = .365$) nor the distance driven ($t(18) = -0.14$, $p = .892$) differed significantly between the two roles of the robot. However, participants did pet the robot longer in the hedonic condition ($M = 140\,\text{s}$, $SD = 159$) compared to the utilitarian condition ($M = 55\,\text{s}$, $SD = 72$), $t(18) = -2.37$, $p = .029$, $d = -.46$. In addition, participants used significantly more utilities when the robot had a utilitarian role ($M = 15$, $SD = 10.95$) compared to a hedonic role ($M = 3.7$, $SD = 4.14$), $t(18) = 5.84$, $p < .001$, $d = .97$.

The differences in behavioral attitude towards the robot between the conditions were clearly visible in the quantitative behavior statistics measured. The qualitative data showed that participants did not notice many behavioral differences or changes themselves. Not many noteworthy aspects of the behavioral attitude were mentioned, other than participants trying out different types of functionalities that the robot was explained to have in each of the conditions.

3.3 Cognitive Attitude

No significant difference on cognitive attitude was found between the utilitarian ($M = 40.53$, $SD = 8.51$) and hedonic ($M = 41.53$, $SD = 9.20$) roles of the robot, $F(1,19) = 0.57$, $p = .461$.

The qualitative data showed that participants were overall impressed by the robot's intelligence. As one participant put it, when trying something new they thought "oh this is *also* something it can do", which may have positively influenced their cognitive attitude toward the utilitarian role of the robot. Some participants mentioned that the social connection provided by the hedonic role of the robot was unnecessary. Their need for social interactions was already satisfied by seeing their friends and family regularly, so having the robot was not necessary for them. This suggests that the hedonic aspects of the robot were less important to them, perhaps influencing their cognitive attitude toward the hedonic role negatively.

Finally, when participants were asked specifically about their attitudes towards both types of robots, it seemed that short-term attitude change is more related to utilitarian aspects and novelty effects, while hedonic aspects seemed more relevant for attitude changes in the long-term.

4 Discussion

The aim of this study was to investigate the influence of the role of a social robot (utilitarian or hedonic) on people's attitude toward that robot. Both the quantitative and the qualitative results indicated that there were differences in people's attitude toward a robot across the roles of that robot. Results showed that hedonic aspects seemed to be more important - as opposed to utilitarian aspects - for people's Affective Attitude. The role of the robot also influenced specific behaviors that people showed towards the robot, as petting duration was higher with the hedonic role of the robot and number of utilities used was higher in the utilitarian condition. No differences between the two roles were found on people's Cognitive Attitude.

Participants' affective attitude was significantly more positive when the robot had a hedonic role compared to a utilitarian role. This finding contrasts our expectations. Through the interviews it became apparent that the majority of participants liked the social aspects of the robot the most and that those aspects elicited feelings of companionship, pride, guilt and loss. As previously emphasized [14,24], this suggests that hedonic aspects of social robots are very important to people's evaluation of (the interaction with) a robot.

The behavioral statistics revealed that participants did use the robot differently between the roles of the robot. As utilitarian aspects are related to more extrinsic objective in the interaction with the robot, and hedonic aspects more to intrinsic value [11,12], people's motivation to interact with the robot might also play a role in their behavior toward the robot. It must be noted however, that the petting instruction was only provided on the information sheet for the hedonic condition and not for the utilitarian condition, which could have led to this difference.

No significant differences were found in participants' cognitive attitude between the conditions, even though the descriptions of the robot given in the interviews do show that the robot in the utilitarian condition was thought of differently than the robot in the hedonic condition. A possible explanation for this could be that different items of the RAS might appeal more to different roles of the robot (e.g., "useful" relating more to utilitarian aspects and "friendly" more to hedonic aspects). Furthermore, the explicit measurement of the cognitive attitude led participants to think about their attitude toward the robot, allowing them to rationalize their answers. In this cognitive effort, overall negative aspects of the robot (e.g., slow responses of the robot, the robot often not understanding the voice commands) might have been weighed against the benefits of the utility (in the utilitarian condition) or the companionship (in the hedonic condition) of the robot, leading to a similar cognitive attitude in both conditions.

Overall, the robot in the utilitarian role and the robot in the hedonic role were regarded as two different robots, indicating that people do view robots differently if they have a different role. The robot in the utilitarian role was often compared to assistants and described as a small machine, computer or tool, while the robot in the hedonic role was mostly compared to a pet and

described as a companion. This is in line with the distinction between utilitarian and hedonic aspects of a robot as described in previous literature [3,5,11,12], and it underlines the success of the manipulation of the role of the robot.

4.1 Limitations and Future Research

We used self-report measures to measure attitude. This means that only the explicit attitude – and not the implicit attitude – was investigated, making the results more vulnerable to several biases [9]. While explicit responses need cognitive resources and are made more consciously, implicit responses relate more to subconscious affective reactions [21,22]. A person's implicit attitude can differ from their explicit attitude, for example due to not being aware of or understanding their attitude, or due to concealing their attitude (e.g., self-presentation or social desirability biases) [17]. Especially as implicit measures are related to the affective attitude, it would be very insightful to investigate the implicit attitude toward social robots - both in general and across the roles of a robot - in more depth.

The home setting of the experiment enabled ecologically valid results, allowing the participants to respond to and interact with the robot as they find comfortable and how they naturally would. This also meant that it was difficult to control for all variables compared to a lab study. However, the distinction between the utilitarian and hedonic roles of a social robot was very pronounced in the qualitative data, highlighting this distinction as a very interesting topic for further research. A more controlled setting allows for a much more focus on the role of the robot, through which more insights into the exact influence of the role of the robot - on perceptions of and interactions with the robot - and the underlying processes can be gained.

4.2 Conclusion

The utilitarian and hedonic roles of the robot seem to be a useful distinction in human-robot interactions, as people described, perceived and interacted with the robot in these two roles differently. While valuable insights into the interplay between the roles of the robot and people's attitude toward the robot were provided, further research is necessary to gain a better understanding of people's complex attitudes toward robots and dive deeper into the underlying processes. An exploratory investigation into attitude change due to interaction with the robot indicated a positive effect and suggested short-term attitude change to be more dependent on utilitarian aspects and novelty effects, while hedonic aspects seemed more important in the long-term. This provided interesting insights into more long-term interaction with a social robot.

Insights from this study enrich our understanding of robots as persuasive technology, and reveal opportunities for further research: utilitarian and hedonic roles of a social robot and attitudes toward robots over time. These topics for further research can hopefully contribute to the development of future social robots and improve the fit between robots and the users' needs.

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