Knowing Me Knowing You: Exploring Effects of Culture and Context on Perception of Robot Personality

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ABSTRACT
We carry out a set of experiments to assess collaboration between human users and robots in a cross-cultural setting. This paper describes the study design and deployment of a video-based study to investigate task-dependence and cultural-background dependence of the personality trait attribution on a socially interactive robot. In Human-Robot Interaction, as well as in Human-Agent Interaction research, the attribution of personality traits towards intelligent agents has already been researched intensively in terms of the social similarity or complementary rule. We assume that searching the explanation for personality trait attribution in the similarity and complementary rule does not take into account important contextual factors. Just like people equate certain personality types to certain professions, we expect that people may have certain personality expectations depending on the context of the task the robot carries out. Because professions have different social meaning in different national culture, we also expect that these task-dependent personality preferences differ across cultures. Therefore, we suggest an experiment that considers the task-context and the cultural-background of users.

Author Keywords Human-robot interaction; personality perception; cultural differences; task context.

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H.5.1 [Information Interfaces And Presentation]: Multimedia Information Systems - Evaluation/methodology;

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INTRODUCTION

Since the fictional play of Josef Capek on Rossum's Universal Robots (RUR) [1] it became popular belief that robots should perform a variety of "dull, dirty, and dangerous" tasks humans would rather not perform by themselves. Certainly, robots are suitable for these kinds of tasks as they are clearly definable, need to be fulfilled accurately, and must be performed exactly the same every time. A recent study by Takayama et al. [10] investigated what jobs people felt a robot should do and could show indeed that people prefer robots for jobs that require memorization, keen perceptual abilities, and service-orientation as long as robots work together with people and do not replace them. Robots move away from the simple and repetitive tasks they were originally designed for. It becomes more interesting to introduce robots in various environments, going beyond the work context, such as the domestic context, the health-care sector, and education. For all these interaction contexts it is important that robots will be socially accepted as sophisticated tools assisting humans or even as companions for the human.

Cultural factor research finds its way into Human-Robot Interaction research. The starting point was the interest into cultural differences in the perception of robots (see e.g. [8]). This research is mainly concerned with the question if and why people with Asians (in particular Japanese) cultural-background experience robots differently compared to people with a Western cultural-background. According to some researchers, a general retention of robots can be observed for Western cultures ([6]; [8]). However, more fine-grained studies, such as the cross-cultural study conducted by Bartneck et al. [2] with Dutch, Chinese, and Japanese participants could already show more subtle cultural influences in the attitude towards robots. They used the Negative Attitude towards Robots Scale to investigate people's attitude towards the interaction with robots. Interestingly, the Japanese participants did not have a more positive attitude towards robots, which was contrary to the authors' expectations.

Similarly, a study on the effect of cultural-background in human-robot cooperation, done by Evers et al. [4], showed that US and Chinese participants respond differently to robot advices. Moreover, they could show that assumptions from human-human interaction cannot universally hold true. A follow-up study by Wang et al. [12] showed that Chinese participants were more likely to comply to robots that communicated implicitly while US participants tended to

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comply with robots that communicated explicitly in a Human-Robot Team setting.

In this work in progress paper, we present a study design with which we want to investigate if the attribution of personality traits to an agent/robot is affected by the cultural-background of the user interacting with it. The study is currently in its data collection phase, but we will present the preliminary results of the first 31 valid participants. We base our work on three assumptions: (1) the attribution of personality traits towards a robot is affected by the task-context in which the human and the robot are interacting, and (2) the attribution of personality traits towards a robot is affected by the cultural-background of the user. In the following we will present related work in the area of socially interactive robots and personality trait attribution, followed by our study proposal for which we will describe in detail our research questions and hypotheses, study design, the manipulation, the participants, the procedure, and the preliminary results. We will close our paper with an outlook on expected results and future work.

SOCIALLY INTERACTIVE ROBOTS

A socially interactive robot can be considered as an embodied intelligent agent, which is designed especially for social interaction with humans. An interesting phenomenon is that users tend to perceive socially interactive agents as well as robots as having personality traits. Various assumptions exist, which try to predict human responses towards agents/robots with personalities, such as the media equation theory and the theory of attraction.

The media equation demonstrates that in many cases users tend to treat computing systems (but also TV and new media) in a social way, "just like interaction in real life" [10] which is a relevant theoretical precondition for our proposed study. The theory of attraction comprises the social similarity and complementary attraction rule, which can be considered as two equally compelling personality-based rules. The similarity attraction rule says that people like others more who are similar to their own personality traits. The complementary attraction rule on the contrary says that people prefer to interact with others whose personality characteristics are complementary to their own ones [7]. Isbister & Nass could show that for disembodied agents on the screen the similarity attraction rule holds true [7], however, for embodied virtual agents and for robots it could be demonstrated that the complementary attraction rule is supported ([7]; [9]).

We assume that it is not exclusively about the complementary or the similarity attraction rule why people prefer a specific personality of a robot, but about the task context and the cultural-background. The correlation between cultural-background and personality traits has already been acknowledged in social-psychology literature. For instance, Hofstede et al. [5] conducted a study, in which he classified over 40 nations according to 5 dimensions, namely power-distance, individualism, masculinity, uncertainty avoidance, and long-term orientation. Furthermore, Hofstede et al. also investigated the link between cultural dimensions and personality traits and could show that e.g. extraversion is positively correlated with individualism and negatively with masculinity [5]. In other words we can expect an influence on the preference of personality traits due to cultural-background.

However, research on personality traits and professions also shows the link between these two aspects. Barrick et al. [3] could demonstrate that managerial tasks correlate with extroversion personality traits, but that a surgeon's tasks and teachers' tasks correlate with introversion. This leads to our assumption that also the task context in which a robot interacts with the human has an influence on the personality traits attribution, besides the cultural-background. In the following we will describe in more detail how we want to investigate these assumptions.

EXPLORING ROBOT PERSONALITY TRAITS

The evidence for ambivalent assumptions on the correlation between robot's personality trait evaluation and the user's personality traits calls for a better understanding of predictors or mediators of a robot's personality evaluation. It is hoped that through a better understanding of the task context and the users' cultural-background as mediators for robot personality evaluation, the utility of personality cues for robots can be better realized for different task contexts.

We assume that trait-relevant situational cues (namely task context and cultural-background) moderate the evaluation/preference of the robot's personality. In other words, we assume that trait attributions are task- and culture-dependent. Thus, we hypothesize that participants will attribute personality traits to robots based on the task-context and on their cultural-background. To investigate this assumption we suggest a two-step study proposal to evaluate the impact of cultural context and task-context on the personality evaluation of robots. The first study will be video-based to get a first indication on our hypotheses (see Woods et al. [13] on the comparability of video-based and interaction-based studies in HRI). Based on the results we want to conduct an actual user study with the same robot and potentially iterated tasks and a different cultural-background distribution. In the following we will describe the design of the first video-based study in more detail.

FIRST STUDY

For the video-based study we use 6 pre-recorded scenarios with the Nao robot (see Fig. 1). We have a 2 (Nao personality: introvert vs. extrovert) by 2 (participant personality) by 3 (task context: introvert vs. extrovert vs. neutral) by 2 (cultural-background: Dutch vs. German) between-subject experiment.

Research Question and Hypotheses

By the means of the above described study design we want to investigate the following two research question and its according hypotheses.

RQ1: Will the assessment of a robot's personality be (a) task-dependent, be (b) culture-dependent?

H1: The task will mediate the personality evaluation of a robot and the user's personality traits.

H2: The cultural-background of the user will mediate the personality evaluation of a robot and the user's personality traits.

H3: The perception of the task context is cultural-background dependent.

RQ2: Will the assessment of interaction quality criteria for the robot (such as perceived enjoyment, intelligence, fun, trust, compliance, and willingness to spend time with the robot) be (a) task-dependent, be (b) culture-dependent?

Method

Our study should be based on 3 different tasks: a task that is particularly associated with extroverted personality traits [3], a task that is associated with introverted personality traits, and a neutral task (tasks not commonly associated with introverted or extroverted personality traits). We will use the Nao robot (see Fig. 1) to increase the potential that users interpret it as a robot that could perform meaningful tasks for/with humans. The tasks the robot will perform in the videos together with humans are based on the above-mentioned study from Barrick et al. [3] such as: teaching a student (robot as introvert teacher), caring about a patient (robot as ambivalent pharmacist, see Fig. 1), discussing the balance sheet of a company (robot as extrovert CEO).

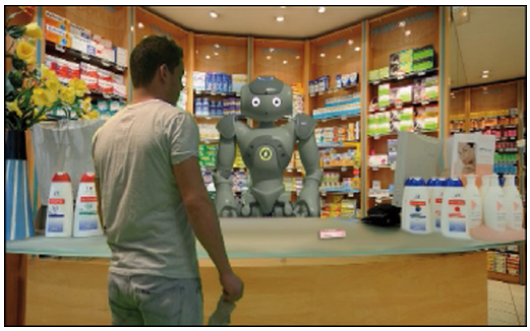

Figure 1: Example scenery out of the video about the interaction with the caring pharmacy robot.

Manipulation

To simulate extrovert and introvert behaviour of the Nao robot, we manipulated verbal cues, namely loudness of voice and speech rate, as these aspects are associated with the judgment of extroversion/introversion. For the manipulation of nonverbal cues we focused on simultaneous manipulation of the moving angle and moving speed for gestures (the wider and faster the more extrovert) and more "autonomous/random" movements for the extrovert robot [9]. To simulate different task contexts (as mentioned above), teaching, caring, and management, we used different backgrounds for contextualization.

Procedure

In the video-based study, participants are asked first to state their age, gender, educational- and cultural-background. Afterwards, they watch one of the 6 different videos, in which the robot is either extrovert or introvert and performs one of the three tasks. Afterwards, participants are asked to answer several questions regarding the watched video. The survey is conducted online and the link is distributed via several student mailing lists of the University of Twente, The Netherlands.

Measures

The cultural-background of the participant for this first study is collected through a binominal self-reported category (Dutch or German). Please note that we are not measuring broad cultural value difference such as power distance or collectivism. We will investigate correlations between shared cultural values and responses in the follow-up study. Extroversion/ introversion of the participants, the perception of the extroversion/ introversion of the Nao robot and of the task context is measured by an index of the Wiggins personality adjectives items [14]. This index is composed of 8 adjectives for introversion (such as silent, shy, inward) and 8 adjectives for extroversion (such as outgoing, jovial, and perky). Furthermore, we added some questions to measure quality criteria, such as perceived enjoyment, intelligence, fun, trust, compliance, and willingness to spend time with the robot.

Preliminary Results

Up to now we could collect 31 valid cases for the online survey so far. Out of these 31 participants, 20 were male and 11 female, 28 were aged between 18 and 25, the other 3 were older. In total 9 introvert and 22 extrovert participants filled in the study, of which 21 participants indicated that they were Dutch and 10 that they were German. Clearly these sample sizes do not allow inferential statistics with meaningful results, however first trends could be found in the data. The videos with the extrovert task are so far rated more extrovert than the videos with the ambivalent task. Similarly, the videos with the ambivalent task were rated more extrovert, than the videos with the introvert task by both Dutch and German participants. There can be no clear tendency observed for the personality perception of the robot depending on the cultural background, however tendencies could be observed that Dutch participants would be less compliant with the robot, but trust it more and that Germans are willing to spend more time with the robot in general.

Similarly, for the robot perception depending on the task-context no significant tendency can be found in the data so far. However, the introvert CEO robot was rated as being the least introvert robot, but the pharmacist was more introvert than the teacher. The task does seem to have a potential effect on the way the participants perceive the introvert robot. During the pharmacist task the robot is perceived to be a lot more introvert and a lot less extrovert than during the other tasks. There is a significant interaction effect between the task and the robot's personality, on the perception of introversion of the robot, $F(3,34) = 3{,}703$, $p = 0.021$.

Regarding the quality criteria the extrovert robot is always rated better in terms of perceived enjoyment than the introvert one, but the task seems to have no effect. For fun the extrovert robot is rated better in the first two tasks, but during the teaching task it is rated quite similar to the

introvert robot. However, the perception of intelligence differs greatly between tasks, but not in the expected way. The introvert CEO robot was perceived to be more intelligent than the extrovert one and the extrovert teacher was perceived to be more intelligent than the introvert one. A bigger sample size will enable us to conduct a deeper data analysis and based on that to inform the design of the second study in terms of the personality design of the robot and the choice of the task-context.

SECOND STUDY

The second study is considered to be a laboratory-based user study in which the users can interactively perform tasks with the Nao robot in similar tasks-context as in the previous video study. We will evaluate actual behaviour in order to assess user responses to the robot rather than self reported attitudinal data as collected in the study described in this paper. Moreover, for the user study we want to add measures for the cultural identity and for the persuasiveness of the robot for the laboratory-based study. For cultural measures we consider broad value differences to show that the cultural groups indeed differ in cultural value orientations, such as collectivism/individualism. For the persuasiveness of the robot we consider to increase the interactivity of the tasks, e.g. in the teaching task the robot could convince the user of a wrong information, in the caring task, the robot could convince the user to choose a specific medicine, and in the CEO task, the robot *could* convince the user to change financial numbers to the better. Additionally, we will use questionnaires to evaluate the persuasiveness of the robot. The model derived from the data of both studies, will offer a unique approach to understand personality evaluation and cultural embedding of tasks in Human-Robot Interaction.

CONCLUSION & OUTLOOK

In this paper we presented the study concept of a video-based study, which has the aim to explore task-dependence and cultural-background dependence of the personality trait attribution on a socially interactive robot. We expect that it is neither the similarity rule nor the complementary rule, but the mediation of the task context and the cultural-background that causes the specific evaluation of a robot's personality. The planned follow-up laboratory-based user study should offer us additional data to investigate these assumptions further. Our overall goal with a cumulative data analysis of both studies is to present a "user personality - cultural-background - task context –robot personality model" that explains under which specific task contexts and cultural pre-conditions the similarity attraction rule or the complementary attraction rule holds true.

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