25th IEEE International Symposium on
Robot and Human Interactive Communication (RO-MAN)
August 26-31, 2016. Columbia University, NY, USA

What are People's Associations of Domestic Robots?: Comparing Implicit and Explicit Measures

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Abstract— **The acceptability of robots in homes does not depend solely on the practical benefits they may provide, but also on complex relationships between cognitive, affective and emotional components of people's associations of and attitudes towards robots. This important area of research mainly relies on explicit measures, and alternative measures are rather unexplored. We therefore studied both implicit and explicit associations of robots, and found inconsistent findings between implicit and explicit measures. Our findings speak in favor of the proposition that people are actually more negative about robots than they consciously express. Since associations play an important role when people form attitudes towards robots we stress that caution when researchers and designers solely rely on explicit measures in their research.**

I. INTRODUCTION

Offering practical benefits doesn't lead to the apparent acceptance of robotic devices in domestic environments. Another aspect of the acceptability of such devices depend on the complex relationships between the cognitive, affective and emotional components of people's attitudes towards robots. Nevertheless, these complex relationships are rather unexplored in robotics research. Moreover, previous research on people's attitudes towards robots have mainly relied on survey data. However, it has been argued that it is insufficient to merely rely on explicit measures [32]. First, because people are not always aware of the attitudes affecting their behavior [13]. Second, because people may conceal their genuine attitudes, which could lead to self-presentational biases. People's attitudes, whether being concealed or not, influence people's behavior [1]. Therefore, studying people's attitudes towards robot using implicit and explicit measures will provide the field of human-robot interaction with a more holistic insight into how people perceive robots.

Several researchers have predicted that domestic robots will become ubiquitous in our everyday lives. This introduction of robots for domestic use is inherent with several challenges, which have to be overcome before domestic robots become successful [47]. This paper investigates the relationships between the cognitive (explicit associations and attitudes towards robots), affective (implicit associations) and emotional (anxiety towards robots) components of people's attitudes towards robots.

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II. THEORETICAL BACKGROUND

This section will present related research on the cognitive, affective and emotional levels of attitude formation, including findings from human-robot interaction research. Based on this theoretical background, we will draw several hypotheses to be tested in our study.

A. Explicit and Implicit Associations

Young et al. [47] argue that the process of accepting and using novel technology, such as domestic robots, lies largely upon the subjective perceptions and associations people hold of robots in terms of what robots are, how they work and what kind of tasks they could (not) be performed within domestic environments. In this study, we focus on both implicit and explicit associations of robots. Implicit associations are affective reactions, which are activated automatically when one encounters a social object [16]. Explicit associations, on the other hand, can best be characterized as cognitive evaluations or judgments. These are usually based on syllogistic inferences which stem from propositional information relevant for making judgments [16]. Administering people's associations of robots is important, because they affect the construction of attitudes regarding domestic robots [35]. And positive attitudes could facilitate the performance of favorable behavior by humans [5], [34], such as accepting domestic robots.

So far, only a few researchers have investigated people's associations of robots. These studies are primarily open and explorative in nature and have mainly focused on explicit measures (i.e., survey data). Studies assessing people's attitudes towards robots conclude that people are generally positive about robots [3], [9], [27], [40], people prefer to be in control [27], people commonly associate robots with household tasks [9] or help for the disabled [40]. However, the referred studies have depended solely on explicit measures, which could comprise several biases [32]. One way of overcoming these biases is to administer peoples' implicit associations. These internal attitudes are left out from an introspective entry even when people are willing and motivated to reveal oneself. Researchers have compared explicit measures with implicit measures on the same topic and have found that the difference between explicit and implicit measures lies in how resistant these are. Explicit measures seem to be less resistant to self-presentational bias than implicit measures [22], especially in the case of sensitive topics [28]. To our knowledge, only the study of

MacDorman et al. [32] has looked into people's implicit associations of robots before. Their results indeed challenge other explicit findings by concluding that people are more negative towards robots than other studies present. Although it is just one study contradicting positive associations of robots in other studies, it is worthwhile to further investigate differences between implicit and explicit associations of robots. Especially when considering that people also associate the rise of robots with negative consequences such as job loss [40], and that robots are perceived as 'cold' creatures [3]. Based on the literature described above, the following hypotheses are formulated:

H1: People implicitly associate domestic robots more with negative words than with positive words.

H2: People explicitly associate domestic robots more with positive words than with negative words.

B. *Attitudes towards Robots*

Researchers [37] created a scale to measure psychological states of humans such as attitudes, anxiety, and assumptions about robots to get a better insight how humans view and respond to robots in daily life. User studies investigating human-robot interaction have incorporated these measures. For example, a video-based experiment investigating physical contact and help styles shows that people with more negative attitudes towards robots perceived the robot as more machinelike and less humanlike [6]. Another experiment explored the effect of the robot's behavior (socially ignorant vs. socially interactive) on the users' behaviors [45], and found that people's prior attitudes towards robots in general could explain the different behaviors of the users. Riek et al. [41] also conducted a video-based experiment, and found that people with more negative attitudes towards robot were less adept to understanding the gestures made by robots.

However, the attitudinal measures in the referred studies are interpreted in the context of a specific interaction with the exact robot employed in that study. Moreover, none of these studies have investigated the relations between people's attitudes towards robots and their associations of robots. Yet, some researchers [34] advocate that future research should focus on these relationships between people's associations and attitudes concerning robots. In addition, other researchers [35] state that people's experiences with robots are related to their assumptions towards robots, and that people's assumptions influence the construction of their attitudes towards robots. This endorses the value of examining the relationships between people's assumptions of and attitudes towards domestic robots. Based on the above findings, the present study therefore investigates the following hypotheses:

H3: Implicit associations about domestic robots are related to attitudes towards domestic robots.

H4: Explicit associations about domestic robots are related to attitude towards domestic robots.

C. *Anxiety towards Robots*

A most common anxiety towards new technology is computer anxiety [44] and its effects on computer use has been studied extensively in the past [7]. With the upcoming rise of domestic robots, it could be argued that anxiety towards robots could become as important as computer anxiety. Anxiety towards robots is defined as 'the emotions of anxiety or fear preventing individuals from interaction with robots' [36]. An important challenge for roboticists is to overcome people's anxiety to adapt and use domestic robots in everyday life. People who need to cooperate with a robot are less anxious towards robot than people who have to compete against a robot [29]. Another study found that people's prior anxiety towards robots has an influence on how much people talked to a robot, and, in return, these interactions had again an effect on people's anxiety levels [21]. However, the context of use has an influence on the level of anxious reactions towards robots [39]. In order to provide guidance for the measurement of people's anxiety towards robot, it could be useful to use people's association of robots as controlled variables in the measurement of consumers' anxiety concerning robots [34], [35]. Therefore the following hypotheses are formulated:

H5: Implicit associations of domestic robots are related to anxiety towards robots.

H6: Explicit associations of domestic robots are related to anxiety towards robots.

H7: Attitudes towards robots are related to consumers' anxiety towards robots.

III. METHOD

A. *Questionnaire and Procedure*

Arras and Cerqui [3] emphasized the notion of a strong link between people's foreknowledge about robots and their acceptance behavior. Furthermore, people could keep multiple concepts of robots in mind, such as industrial, humanoid or domestic robots. This could influence the reactions of participants in robotics research [35]. MacDorman et al. [32] suggested providing a clear idea of what type of robot is under study. Since we focus on domestic robots, the questionnaire started with the sentence: "The purpose of future domestic robots is to perform a bunch of household tasks, such as cleaning and cooking". The questionnaire was conducted at an internet-accessible website. The sections with implicit measures and the section with explicit measures were randomly presented to the participants to avoid order effects.

The participant's explicit associations of robots were administered using two open-ended questions. We asked the participants to provide their first thoughts when hearing the word 'robot' including what words they associate with robots. Two independent raters indicated whether each association could be indicated as either positive or negative. Cohen's kappa was used to measure the interrater agreement adjusted for chance, which showed a substantial level of agreement (Cohen's kappa= .72, $p < .001$) [30].

The participants' implicit associations of domestic robots were administered using an implicit associations test (IAT). The well-known IAT, developed by Greenwald et al. [23], has its foundations in psychology and is a method for measuring automatic evaluations of numerous concepts [38]. The IAT could be useful for diagnosing several socially significant associative structures, and has been successfully applied in robotics research [32]. The IAT does not require the participants' cognitive capacity or their intention to evaluate an object, which is especially useful when the object of interest is an unknown or relatively new object [8], such as domestic robots. In this study, the IAT was used to identify the differential associations of two concepts (domestic robots and humans) alongside the attribute dimensions of positive and negative words, which are based on response latencies of a categorization task [22]. The IAT used in this study is adapted from MacDorman et al. [32] and consisted of five blocks with categorization tasks. In the first block respondents had to distinguish several items, which associated most with the target concept (robot or human respectively). In the second block, respondents had to distinguish several items, which associated most with the attribute dimensions (positive and negative words respectively). In the third block, the tasks of both the first and the second block were thrown together at the same time. In this case, the participants had to associate positive words or robot images to the left hand key, and negative words or human images to the right hand key. The fourth block was the same as the first block, however the target concepts were presented reversed. Thus, the participants had to respond to either the robot images or human images with the other hand. In the fifth and last block, the tasks of the third block were presented in interspersed form. In this case, the participants had to associate positive words or human images to the left hand key, and negative words or robot images to the right hand key. For the final analysis, only the third and fifth block of categorization are of interest to measure people's implicit associations of robots. The underlying assumption is that respondents who have stronger associations of robots with positive words than negative words, should perform block 3 faster than block 5 [32]. The strength of the associations can be indexed by the response latencies of these associations generated by the participants [38]. Table 1 shows an overview of the categorization tasks of the five tasks in the IAT. The number of trials and the frequency of used categorization tasks is consistent with existing research [24], [32]. Moreover, block 3 and block 5 were also crosswise counterbalanced to rule out alternative explanations for our results (e.g., faster on the right key, faster later in the session). Thus, participants randomly first had to assign robot images or positive words to the left-key and human images or negative words to the right-key, whilst others first had to assign robot images or negative words to the left hand key and human images or positive words to the right-key.

Characteristics of the IAT such as its magnitude and reliability seem to be less affected by the number of stimulus items per category used [38]. Therefore, it was chosen to use ten silhouettes of humanoid robots, which represented the target concept robot, and ten silhouettes of human beings, which represented the target concept human. Silhouettes were chosen instead of photographs, because silhouettes will prevent the participants from identifying the race of the human stimuli. The used silhouettes in this study (see figure 1) are similar to those used in the study conducted by McDorman et al. [32]. Manipulations checks (n= 10) were conducted whether the silhouettes of robots and humans, and positive and negative words were perceived by respondents, as intended by the researcher. The robot silhouettes were judged to have a more robot appearance ($M= .96$, $SD= .20$) compared with the human silhouette ($M= .04$, $SD= .19$), $t= 23.36$, $p < .001$. The human silhouettes were judged to have a more human appearance ($M= .97$, $SD= .17$) compared with the robot silhouette ($M= .03$, $SD= .17$), $t= 27.41$, $p < .001$. The positive words were judged as being more positive ($M= .99$, $SD= .10$) than negative words ($M= .01$, $SD= .10$), $t= 26.45$, $p < .001$. The negative words were judged for being more negative ($M= .98$, $SD= .14$) than the positive words ($M= .02$, $SD= .14$), $t= 24.72$, $p < .001$. The results of the manipulation check thus indicated that the silhouettes are appropriate for the purpose of this study.

TABLE I. CATEGORIZATION TASKS FOR ROBOT VS. HUMAN AND POSITIVE VS. NEGATIVE WORDS

Block	**No. of Trials**	**Function**	**Items assigned to left-key**	**Items assigned to right key**
1	20	Practice	Robot images	Human images
2	20	Practice	Positive words	Negative words
3	40	Test	Robot images & Positive words	Human images & Negative words
4	20	Practice	Human images	Robot images
5	40	Test	Human images & Positive words	Robot images and Negative words

TABLE II. DESCRIPTIVE STATISTICS OF ANXIETY AND ATTITUDE TOWARDS ROBOTS

Construct	**Abbreviation**	**Mean**	***SD***	***α***
Attitude towards interaction with robots	NARS S1	5.40	0.68	.70
Attitude towards the social influence of robots	NARS S2	4.14	1.63	.91
Attitude towards emotional interactions with robots	NARS S3	5.68	0.76	.79
Anxiety towards communication capacity of robots	RAS S1	3.62	1.21	.89
Anxiety towards behavioral characteristics of robots	RAS S2	2.95	0.95	.84
Anxiety towards discourse with robots	RAS S3	3.04	1.23	.78

Figure 1. Robot and Human Silhouettes Used in the IAT test

The respondents' attitudes and anxiety towards robots were measured with the scale as developed by Nomura et al. [37]. The negative attitude towards robots scale reflects people's attitudes towards robots by evaluating their psychological states which reflect the opinions people ordinarily have towards robots. The scale is divided into three subscales with a total of 14 items: negative attitude towards interaction with robots (NARS-S1); negative attitude towards the social influence of robots (NARS-S2); and negative attitude towards emotional interactions with robots (NARS-S3). The scale which measures anxiety towards robot considers anxiety towards robots evoked in real-time and imaginary interaction scenario's with robots. The scale is divided into three subscales with a total of 11 items: anxiety towards communication capacity of robots (RAS-S1), anxiety towards behavioral characteristics of robots (RAS-S2), and anxiety towards discourse with robots (RAS-S3). We presented the items on a 7-point Likert scales from 'strongly disagree' to 'strongly agree', and translated all items from English to Dutch using the back-translation process which was completed by two bilingual speakers. This process ensures that meaning and nuance of the construct are not lost, and that the translated versions of the construct remains as true to its original version as possible [33]. Reversed coded items were recoded. Moreover, the negative attitude towards robots scale was reversed in its whole in order that a higher score would indicate a more positive attitude towards robots, which was needed to properly test the formulated hypotheses. In Table 2, the constructs and their descriptive statistics are presented.

C. *Participants*

A total of 207 participants (94 male and 113 female) aged between 15 and 65 years old (M= 25.27, SD= 9.02) took part in this study. Since most participants were students from a Dutch university, the education level of the participants was relatively high with 16.4% having an intermediate vocational educational background, 34.3% having a Bachelor's degree and 49.3% having a Master's degree.

IV. RESULTS

We used the results from the IAT to test the first hypothesis. Calculating the measure of association strength for testing hypothesis was analogous with the procedure described in Greenwald et al. [22]. Within this procedure outcomes of the practice blocks (blocks 1, 2 and 4, see table 1) were excluded from further analyses. Furthermore, error rates and the first two trials of each block per participant were dropped, because of their typically lengthened latencies responses [22]. Within the analysis latencies were capped to a range between 0.3 seconds and 3 seconds. According to Greenwald et al. [23] this is a recoding solution to the problem of outlying data by simply dropping trials outside the 0.3 seconds and 3 seconds. Additionally, the advantage of using a recoding solution means that it is less sensitive to (1) differences among conditions in the proportions of trials in the upper versus lower tails and (2) the choice of specific lower and upper boundaries. Also, the analyses were carried out on log-transformed latencies, though untransformed mean latencies were reported (in seconds).

A paired-samples t-test was conducted to compare the mean latencies of the robot positive IAT and robot negative IAT. There was a significant difference in scores for the robot positive IAT (M= 1.26, SD= .34) and the robot negative IAT (M= 1.12, SD= .25), t= 6.26, $p < .001$. These results indicate that respondents, on average, had stronger negative than positive implicit associations with robots, which supports hypothesis 1.

To investigate the second hypothesis, we looked at the content analysis to classify the explicit associations of robots into a positive or negative category. The results showed that 75.8% of the participants had a positive explicit associations with robots and 24.2% a negative one, which is in favor of accepting hypothesis 2.

To test the third hypothesis, we performed a Pearson correlations test between people's implicit associations and their attitudes towards robots. A total of three correlation tests were performed, between the implicit associations and NARS-S1: attitude towards interaction with robots (r= -.164, p= .018), between the implicit associations and NARS-S2: attitude towards the social influence of robots (r= -.128, p= .065), and between the implicit associations and NARS-S3: attitude towards emotional interactions with robots (r= -.117, p= .093). These findings suggest a weak correlation between implicit associations and attitude towards robots, weakly supporting hypothesis 3.

To test the fourth hypothesis, we performed a Biserial correlations test between people's explicit associations and their attitudes towards robots. A total of three correlation tests were executed, between explicit associations and NARS-S1: attitude towards interaction with robots (r= .078, p= .264), between explicit associations and NARS-S2: attitude towards the social influence of robots (r= .132, p= .058), and between explicit associations and NARS-S3:

attitude towards emotional interactions with robots ($r= -.022$, $p= .757$). We can conclude that none of the correlations were found significant, which made us reject hypothesis 4.

The fifth hypothesis was tested by performing a Pearson correlations test between people's implicit associations and their anxiety towards robots. A total of three correlation tests were executed, between the implicit associations and RAS-S1: anxiety towards communication capacity of robots ($r= .319$, $p < .001$), between the implicit associations and RAS-S2 anxiety towards behavioral characteristics of robots ($r= .224$, $p= .001$), and between the implicit associations and RAS-S3: anxiety towards discourse with robots ($r= .157$, $p= .024$). Although the correlations are weak, the results confirmed hypothesis 5.

To test the sixth hypothesis, we performed a Biserial correlations test between people's explicit associations and their anxiety towards robots. A total of three correlation tests were executed, between explicit associations and RAS-S1: anxiety towards communication capacity of robots ($r= -.227$, $p= .001$), between explicit associations and RAS-S2: anxiety towards behavioral characteristics of robots ($r= -.190$, $p= .006$), and between explicit associations and RAS-S3: anxiety towards discourse with robots ($r= -.244$, $p < .001$). Although, again, the correlations are weak, the significant correlations confirmed hypothesis 6.

To test the seventh hypothesis, we performed a Pearson correlations test between people's attitudes towards robots and their anxiety towards robots. A first set of correlations were executed between NARS-S1, attitude towards interaction with robots and the three sub scales of anxiety towards robots: RAS-S1, anxiety towards communication capacity of robots ($r= -.411$, $p < .001$); RAS-S2, anxiety towards behavioral characteristics of robots ($r= -.285$, $p < .001$); and RAS-S3, anxiety towards discourse with robots ($r= -.335$, $p < .001$). A second set of correlations were executed between NARS-S2, attitude towards the social influence of robots and the three sub scales of anxiety towards robots: RAS-S1, anxiety towards communication capacity of robots ($r= -.402$, $p < .001$); RAS-S2, anxiety towards behavioral characteristics of robots ($r= -.408$, $p < .001$); and RAS-S3, anxiety towards discourse with robots ($r= -.387$, $p < .001$). And a third, and last, set of correlations were executed between NARS-S3, attitude towards emotional interactions with robots and the three sub scales of anxiety towards robots: RAS-S1, anxiety towards communication capacity of robots ($r= -.150$, $p= .031$); RAS-S2, anxiety towards behavioral characteristics of robots ($r= -.085$, $p= .225$); and RAS-S3, anxiety towards discourse with robots ($r= -.009$, $p < .898$). Since the last two correlations were non-significant, the results only partially confirmed hypothesis 7.

V. Discussion

The study is proposed to administer both implicit and explicit measures to overcome the biases of people's self-presentational strategies. Furthermore, administering implicit measures for attitudes may be important for understanding users' behaviors, particularly in situations when consumers are cognitively constrained, for example when novel technologies are introduced [12] such as domestic robots. So far, only a few robot studies investigating attitudes towards robots have included implicit measures. Therefore, this study will fill this gap by exploring both people's implicit and explicit associations of domestic robots and the influence of these associations on the construction of attitudes towards domestic robots.

Although people explicitly expressed they have positive associations of robots, their implicit associations indicate the opposite. Additionally, there was no significant correlation between the two types of associations ($r= -.101$, $p= .146$). Other researchers also found non-significant correlations between implicit and explicit measures [14], which indicates that both measures are independent concepts of associations of robots. The conflicting associations combined with the non-significant correlation between these two measures could indicate that people implicitly have different opinions about robots than they explicitly want to reveal. Moreover, the non-significant correlation between explicit associations of domestic robots and people's attitudes towards robots, together with the negative correlation between the people's implicit associations of robots and their attitude towards interaction with robots, further advocates our premise that people's negative implicit associations are the more genuine ones. Additionally, both people's implicit and explicit associations of robots are related to anxiety towards robots. However, more negative implicit associations are connected to higher levels of anxiety, and more positive explicit associations are connected to lower levels of anxiety. Again, there is a friction between implicit and explicit association of robots. And, again, these findings speak in favor of our proposition that people are actually more negative about robots than they consciously express.

Research on implicit measures was originally initiated partially by a supposed inconsistency between decreasing levels of explicit prejudice and ongoing patterns of discrimination against several monitory groups. Contemporary models of stereotyping and prejudice focus on different aspects, however, they all reflect on overall expectations concerning the predictive validity of measures for explicit and implicit attitudes. These models agree that implicit attitudes are activated automatically and therefore presumed to guide behavior by default unless they are overruled by conscious cognitive processes [2]. Hence, human's primarily behavior which is not consciously monitored or which is difficult to control such as nonverbal behavior, as well as behaviors considered to be indicative of prejudice should be guided by implicit prejudicial attitudes. Explicit attitudes on the other hand, will be better at predicting behaviors that are under volitional control and whose implications for prejudice are apparent [10]. Research suggests that people explicitly express unprejudiced attitudes while maintaining their negative feelings towards such minority groups. Implicit and explicit attitudes only correlate weakly with each other, and implicit attitudes incline to be better predictors of subtle expressions of prejudice such as nonverbal behaviors compared to explicit attitudes [13]. Based on this work, we would conclude that the difference between people's implicit and explicit associations of robots might be caused by people experiencing a social pressure express positive attitudes towards robot technology while this is not how they truly feel. However, this inclines that implicit measures should be considered as more genuine than explicit measures, which is an assumption that has been postulated by [13]. Judgments and behavior can be predicted by implicit and explicit measures [11], [12]. Still, when motivation and or opportunity are low, behavior is expected to be mainly a result of the automatically activated attitude, and hence, the implicit measure should provide predictive power. On the other hand, when motivation and or opportunity are high, behavior is expected to be mainly a result of the same motivational forces as the explicit measure have shown. Based on this line of thought, we are still in the blind of whether the implicit or explicit associations are the more genuine ones.

Our study was online based without any real life human-robot interactions. Therefore, future research on implicit and explicit associations of robots should further investigate the predictive power of implicit and explicit measures on actual behavior in human-robot interaction scenarios to make further conclusions about the explanatory power of implicit and explicit associations of robots. Emotional responses to robots influence people's evaluations [21], [42], and such emotional responses are likely to enlarge when confronted with real robots compared to robot representations [25]. Therefore, it is essential to verify our current findings in real human-robot interaction scenarios. Additionally, earlier research denotes that when users develop experiences with a technology or gain usage skills, this might change the user's attitudes towards that technology [26], [48]. Similar results were found for people's experiences with robots long-term studies [15], [17], [19]. Only when robots become ubiquitous within society, we can start to investigate more stable implicit and explicit associations together with prejudiced attitudes towards robots.

Besides adding a real life human-robot interaction for further analysis, future research should also further investigate the effect of the provided definition, stimuli or interaction scenario on the explanatory power of implicit and explicit measures. In our study, we provided the participants with a description of a future domestic robot proving household tasks. However, we can imagine that other descriptions of other future purposes, such as a robot providing assistance in a health care scenario, could result in different findings than those presented in our paper. Moreover, we had chosen to use the same stimuli as used by MacDorman et al. [32] who have performed a similar study on implicit associations of robots. However, the stimuli consisted of silhouettes representing only humanoid robots. From our previous work [18], [20] we have learned that people's evaluations of robots differentiate between embodiments or appearances. Therefore, replication of our study is necessary with different robotic appearances.

Another limitation of our study can be found in the participants sample. Most participants in our study were students from a Dutch university. Differences in opinions about robots have previously been found for gender, age and educational level [43], as well as for cultural background [4], [31]. Consequently, another interesting direction for future research is to investigate the explanatory power of implicit and explicit measures among other demographic profiles than those used in our study.

VI. Conclusion

This study contributes valuable insights for domains in robotic research, communication and psychology by examining people's opinions towards domestic robots. The contradiction between the implicit and explicit associations of domestic robots could indicate two different scenarios. It could be that people in fact have a more negative view on future domestic robots than that they reveal in robot questionnaires, but seem to think they should be positive about this topic due to experienced social pressure. Another explanation could be that people are not motivated to control their opinions about domestic robots which results in their positive explicit associations to be their truthful attitude towards robots.

Furthermore, the findings of this study contribute to both the societal and business level. From a societal point of view, it is proposed that domestic robots have the potential to assist the growing rate of elderly people and could assist households for saving time. Examining the acceptance, exploration of attitudes and robot anxiety and administering implicit and explicit measures towards robots will contribute to a better understanding of domestic robots adoption. Furthermore this research contributes to business instances, since administering implicit and explicit associations combined with attitudes towards robots could be useful for effectively introducing domestic robotics adapted to their consumers.

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