The effects of an impolite vs. a polite robot playing rock-paper-scissors

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Abstract. There is a growing interest in the Human-Robot Interaction community towards studying the effect of the attitude of a social robot during the interaction with users. Similar to human-human interaction, variations in the robot's attitude may cause substantial differences in the perception of the robot. In this work, we present a preliminary study to assess the effects of the robot's verbal attitude while playing rock-paper-scissors with several subjects. During the game the robot was programmed to behave either in a polite or impolite manner by changing the content of the utterances. In the experiments, 12 participants played with the robot and completed a questionnaire to evaluate their impressions. The results showed that a polite robot is perceived as more likable and more engaging than a rude, defiant robot.

1 Introduction

The attitude of a robot is an essential feature for creating socially interactive robots. Studies on this matter are aimed at enhancing the Human-Robot Interaction (HRI). In this work, we focus on studying how the robot's verbal attitude alters its attributions. To achieve our goal, we have created a HRI scenario involving real users and a social robot. In the experiment, the robot and the users played, one at a time, rock-paper-scissors. We modified the robot's attitude by changing the verbal content of its utterances. Then, in some cases, the robot used polite words whereas, in others, the utterances were rude and impolite. The only difference between the polite and the impolite attitudes were the utterances the robot said, the rest of the game remained unchanged.

In the literature, we can find some works focused on studying the robot attitude during the interaction. In this regard, Cramer found that a positive robot's attitude was preferred by the users over an accurate robotic empathic behavior [3]. Furthermore, Lee et al. [5] conducted some experiments using the robot dog Aibo where the robot's personality changed between introvert and extrovert. The first conclusion that they found was that participants could accurately recognize a robot's personality based on its verbal and nonverbal behaviors. The second conclusion was that the participants preferred interacting with a robot with an opposed personality rather than a similar one. Moreover, Leite et al. described in [6] a robotic game buddy with different behaviors regarding the state of the game. The results of the experiments indicated that a social robot with emotional behavior could perform better the task of helping users to understand a gaming situation. Besides, user's enjoyment is higher when interacting with a robotic embodied character, compared to a screen-based version of the same character. Short et al. [12] showed that a cheating robot playing rock-paper-scissors was perceived by users more engaging than a fair robot (not cheating).

A recent work [13] focuses on assessing the effect of a robot's attitude (positive vs. negative) on the Uncanny Valley phenomenon using a live interaction paradigm. Results shown that the effect of a robot's attitude is not independent of its embodiment; that is, a robot which is perceived as uncanny is not able to affect its likeability by a positive or negative interaction. On the other hand, the impact of a machine-like robot's attitude is much greater and especially when it behaves negatively as it can lose all its initial likeability. Other recent work by Salem et al. [10] investigated culture-specific determinants of robot acceptance and anthropomorphization. Authors also manipulated the robot's verbal behavior in experimental sub-groups (Arab and English) to explore different politeness strategies. Results suggested that Arab participants perceived the robot more positively and anthropomorphized it more than English speaking participants. In addition, the use of positive politeness strategies and the change of interaction task had an effect on participants' HRI experience. In a prior work, Salem et al. stated that the politeness levels do not have a relevant effect on the user's perception of a robot during the interaction, but the interaction context does [9]. In a Japanese study, Nomura and Saeki studied politeness based on robot poses [7]. In this study, the robot asked Japanese participants to manipulate several objects on a desk using different body gestures. Robot's polite motions had effects on the human impressions of the robot and they found gender differences. Additionally, the intuitive trust people tend to feel when encountering robots in public spaces has also been studied. Inbar [4] presented test subjects with static images of a robot performing an access-control task, interacting with younger and older male and female civilians. The robot showed polite or impolite behavior. Results showed strong effects of the robot's behavior and, besides, age and gender of the people interacting with the robot had no significant effect on participants' impressions of the robot's attributes.

In the same line, in the present work we study how the robot's verbal attitude, polite or impolite, affects its attributions by users that have been engaged in a real interaction. Therefore, our initial hypothesis, *H0*, is that the verbal attitude of a robot influences the perceived Anthropomorphism, Animacy, Likeability, Perceived Intelligence, Perceived Safety and Engagement. To the best of our knowledge, the different attributions to a polite, friendly robot and to an impolite, defiant robot has not been evaluated yet. Researchers have not confirmed whether a conversational robot using defiant, rude utterances could be perceived as more appealing and engaging than a kind, charming one during a competitive game. The goal of this preliminary study is to shed light on this question.

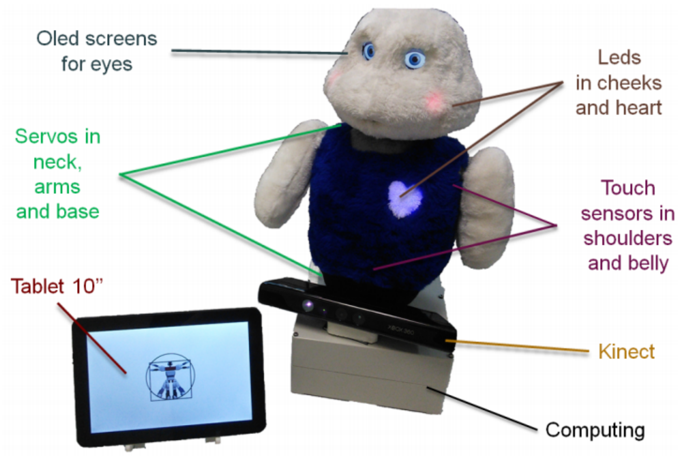

Fig. 1: The social robot Mini used in this study.

The rest of the document is structured as follows. In Section 2, we detailed the experiment: the robot, the HRI scenario, and the procedure. Next, Section 3 shows the evaluation conducted and the results obtained. Finally, we conclude the paper in Section 4 where we discuss the results and present the main limitations.

2 Experiment

To evaluate the effects of the robot's verbal attitude, polite vs. impolite, we have developed a game where our social robot Mini plays a competitive, interactive game with participants. This section describes the design of the experiment, including the details of the game and the robot.

2.1 Robotic platform: Mini

The game scenario presented in this work is implemented on the robotic platform Mini, designed and built at RoboticsLab research group from Carlos III University of Madrid. Originally, the robot was designed to interact with mild cognitive impaired elderly people [11] although the capabilities of the platform are flexible enough as to be used with a wide range of users. Its plushy body gives it a friendly appearance.

The robot Mini (see Fig. 1) is endowed with multiple HRI interfaces to ease the communication with people. Mini has LEDs in its cheeks and heart, screens that constitute its eyes, and a VU-meter like mouth. Some motors allow moving the arms and head to complement the illusion of a living entity. Regarding sensors, the robot Mini is equipped with touch sensors distributed throughout its body, a *Microsoft Kinect* RGB-D camera and a *LeapMotion* device [2]. This latter is used in this work for hand pose detection and recognition. The robot is also equipped with a tablet to show multimedia content as well as games. Furthermore, the robot Mini is able to synthesize voice by a Text-To-Speech (TTS) skill. Finally, Mini's software architecture relies on ROS [8], a framework for developing robot software which provides a collection of tools and libraries to simplify the task of creating robot behaviors across robotic platforms.

2.2 Interactive game scenario: rock-paper-scissors

This work uses a rock-paper-scissors game specifically designed to assess the robot's attributions of users. We use the *LeapMotion* as input for a game in which the user tries to beat the robot. Apart from this device, the interaction modalities of the robot are composed by a tablet that shows the robot's gesture and the result of each round, a TTS module that enables voice interaction, and motors to allow moving head and arms to perform gestures.

Rock-paper-scissors is a zero-sum hand game played in this work by the robot and the user in which each player simultaneously forms one of three shapes with an outstretched hand. These shapes are *rock* (a simple fist), *paper* (a flat hand), and *scissors* (a fist with the index and middle fingers together forming a V). The game has only three possible outcomes other than a tie: a player who decides to play rock will beat another player who has chosen scissors (rock crushes scissors) but will lose to one who has played paper (paper covers rock); a play of paper will lose to a play of scissors (scissors cut paper). If both players choose the same shape, the game is tied.

In terms of operation, the dynamics of the game are simple, the robot displays a countdown in the tablet while saying outloud "Rock-Scissors-Paper, now!" to synchronize the moves of both players. Then, the robot shows its selection in the tablet and waits for the user to reveal her own one by placing her hand above the *LeapMotion* device. Finally, the robot shows a comparison of the moves in the tablet while verbally announcing the winner. At the end of each round, depending on the verbal attitude selected (see Section 2.3), the robot will use polite or impolite sentences. The game continues until the user expresses her intention of stopping playing. Note that the robot's gesture is chosen randomly in each game round.

It is important to emphasize that the robot works autonomously during the game, giving directions to the user at the beginning, and continuously interacting with the user. A experimenter just started the game when a participant arrives.

2.3 Conditions

Since the aim of the paper is to study how HRI is affected by the robot's attitude towards the user, we have established two conditions related to different verbal interaction modalities: polite and impolite. In the polite condition, the robot encouraged and stimulated the participant using nice, positive words. On the contrary, in the impolite condition, the robot's utterances consisted on unpleasant, rude, defiant utterances. Examples of the different utterances used in

Table 1: Some examples of the robot's utterances depending on the condition and the game situation.

Condition	**Game situation**	**Utterance**
Polite	Robot wins	I was lucky, you'll do better next time!
		Let's play again!
	Human wins	You are a great player!
		Congratulations, you play great!
	Tie	Very good, I'm not able to win
		We are both great players!
	Nothing detected	I believe you were to fast
		I couldn't detect your move
Impolite	Robot wins	You are a lousy player
		I would be ashamed if a robot beat me
	Human wins	You are not smart enough to win always
		I'm sure you cheated
	Tie	Loser, you cannot win
		Only humans are such a bad players
	Nothing detected	You fool, play when I say so
		You are an incompetent human, show your move!

both conditions are presented in Table 1. Note that the utterances are originally spoken in Spanish and Table 1 offers an approximate translation into English.

According to the result of each round (user wins, robot wins or tie), the robot selected randomly among a set of utterances depending on the condition. In the case that the robot is not able to recognize the user gesture, it reacts to this situation too with the appropriate utterances.

2.4 Participants

Sixteen native Spanish speakers were recruited among the faculty personnel and students of our university for the study. Due to technical issues, data from four of them were discarded. Out of the 12 remaining subjects, 42.1% were female and 57.9% were male with ages ranged from 22 to 61 years. The study took place at the premises of the RoboticsLab at Carlos III University of Madrid. The number of participants in each condition was: 5 for the polite robot and 7 for the impolite attitude.

2.5 Procedure

The testing phase followed a thorough procedure lead to assess our hypothesis in an objective way. The main steps are depicted in Figure 2 and the following paragraphs describe the process, with the main steps that matching the numbers in the figure. The experiment was divided into two phases, the first one consisted on playing rock-paper-scissors with the robot and, in the second one, the participants had to complete a questionnaire to assess their interaction during the game.

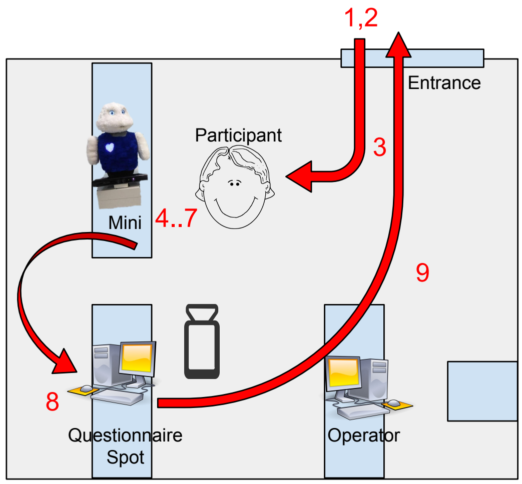

Fig. 2: Experimental setup. Arrows show the transitions between the relevant areas and the numbers are associated to the relevant actions during the experiments described in the text.

Prior to each test and away from the experiment location, participants were informed about their participation in the study and requested to sign an informed consent as well as an optional video recording consent (1). Those who did not sign the second consent proceeded with the experiment without being filmed while the first consent was mandatory to participate in the experiment. Subjects were informed that they could play as long as they like and leave the experiment at any time (2). After the subjects agreed to sign the consents, the experimenter accompanied the participant to the game zone and introduced the robot as well as the game rules and procedure (3). Once players were seated in front of the robot, the main items for the experiment were presented: the robot, the *LeapMotion* (placed between user and robot enclosed in a black rectangle), and the tablet (used for displaying the robot moves and the result of each round). Additionally, participants received some directions about how to play the game (4).

Before the game started, the participants played several demo rounds to get familiar with the game mechanism and the detection device (5). Once a participant felt comfortable, the experimenter left her alone with the robot and the game started (6). The game followed the same rules as the traditional one, being the robot the one leading autonomously the rounds by saying "rock, paper, scissors, now!" and displaying information in the tablet as described in Section 2.2. However, there was a big difference regarding the game: the robot Mini used one of the attitudes (polite/impolite) described in Section 2.3. The game condition was randomly selected but taking into account a balanced number

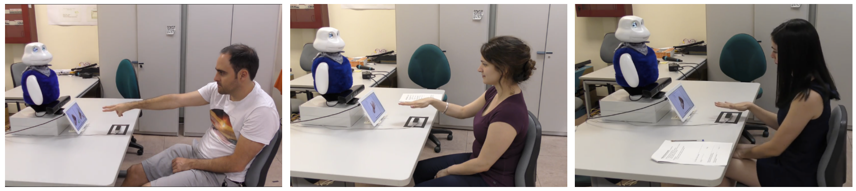

Fig. 3: Participants during the experiment

of users in each condition. Each participant played only in one condition (7). When a subject expressed that she wanted to stop playing, the supervisor went back to the game area and invited the participant to fill an online questionnaire to assess her perception of the robot (8). After filling the questionnaire, the supervisor thanked the participant for being involved in the experiments and it concluded (9). Although the robot in the tests ran autonomously, there was a human operator monitoring the whole process, making sure that everything was running properly. Participants did not notice the involvement of this operator.

3 Evaluation and results

In order to measure the effects of the different verbal attitudes of a social robot, we have conducted a statistical analysis of the data provided by the participants after their interaction with the robot Mini. All participants completed an extension of the Godspeed Questionnaire Series (GQS) [1]. GQS has been extensively used in robotics and was designed to measure the users' perception of robots. It is one of the most frequently used questionnaires in the field of HRI with over 320 citations as of May 2016. In our study, participants rated the robot using the 5 scales included in the GQS: *Anthropomorphism*, *Animacy*, *Likeability*, *Perceived Intelligence* and *Perceived Safety*. And, in order to evaluate the engagement of the participants, we added an extra scale named *Engagement*.

Before running the statistical analysis, we filtered non-valid data from participants that experienced technical failures during the interaction. After that, we ended up with valid data from 12 participants: 5 subjects interacting with a polite robot, and 7 subjects interacting with an impolite robot. First, we analyzed the correlation among the items belonging to the different scales. We observed that all items in the same scales were positively correlated but in the Perceived Safety scale. Here, one item was negatively correlated, and we reversed its values. Then, in order to estimate the internal consistency of the questionnaire, we calculated the Cronbach's Alpha for the different scales. We maximized the reliability for each scale by removing the items that lowered it. Table 2 presents the final Cronbach's Alphas for all scales. All scales present α-values higher than 0.8 which represent high consistent, reliable scales.

Six Mann-Whitney tests (non parametric test for independent samples) were conducted to compare the attributed anthropomorphism, animacy, likeability, intelligence, safety, and engagement to a polite (condition I) and to an impolite

Table 2: Items in the scales

Scale	Cronbach's Alpha	Items
Anthropomorphism	0.894	Fake - Natural Machinelike - Humanlike Unconscious - Conscious
Animacy	0.911	Dead - Alive Stagnant - Lively Mechanical - Organic Artificial - Lifelike Inert - Interactive
Likeability	0.905	Dislike - Like Unfriendly - Friendly Unkind - Kind Unpleasant - Pleasant Awful - Nice
Perceived Intelligence	0.818	Incompetent - Competent Ignorant - Knowledgeable Unintelligent - Intelligent Foolish - Sensible
Perceived Safety	0.808	Anxious - Relaxed Calm - Agitated Quiescent - Surprised
Engagement	0.833	Disappointing - Motivating Never again - Play again Awkward - Easy

(condition II) social robot. We did not find statistical significant differences for anthropomorphism, animacy, perceived intelligence, and perceived safety, but we did for likeability and engagement. The results indicated that likeability was greater for a polite robot (Mdn = 4.400) than for an impolite robot (Mdn = 3.200), $U = 5.000, p = 0.037$. Similarly, the engagement was rated significant higher for a polite robot (Mdn = 4.000) than for an impolite robot (Mdn = 3.666), $U = .000, p = 0.004$. Table 3 shows the actual significance value of the test. The mean values for the scales likeability and engagement are presented in Figure 4.

These results suggest that the verbal attitude of a social robot interacting with a person does have an effect on its attributions of likability and engagement, which partially confirms our initial hypothesis, *H0*, for such categories . Specifically, our results suggest that a polite robot is more likable and people will interact more with it than with an impolite robot during a competitive game.

4 Conclusions

In this work we have presented a preliminary study to assess how the verbal attitude of a social robot alters its attributions during a real, competitive, interactive game with people. Initially, we suggested that an impolite, rude robot could improve the engagement of the participants in the interaction because they could perceive it as funny or even as if the robot were challenging them. However, we have found that a robot using a polite attitude was perceived as more likeable and engaging than an impolite one. It is clear that a robot using

Table 3: Test statistics and the statistical significance (2-tailed) p-value, given $sig \leq 0.05$.

	Anthropomorphism	Animacy	Likeability	Perceived intelligence	Perceived safety	Engagement
Mann-Whitney U	12,000	16,500	,000	9,500	8,000	5,000
Wilcoxon W	27,000	31,500	28,000	37,500	23,000	33,000
Z	-,904	-,165	-2,857	-1,335	-1,559	-2,082
Asymp. Sig. (2-tailed)	,366	,869	,004	,182	,119	,037
Exact Sig. [2*(1-tailed Sig.)]	,432[b]	,876[b]	,003[b]	,202[b]	,149[b]	,048[b]

a. Grouping Variable: Polite=0,Impolite=1

b. Not corrected for ties.

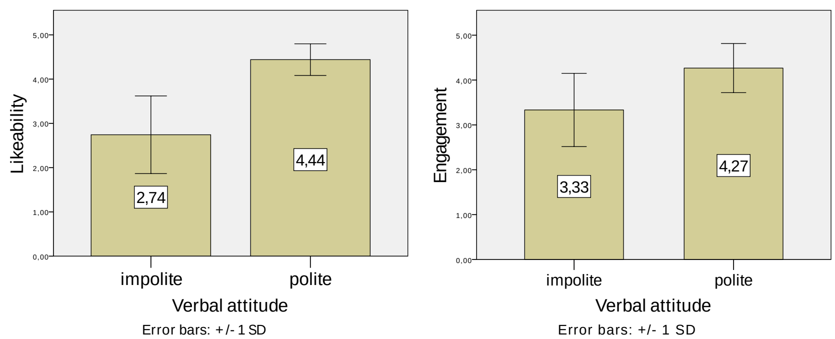

Fig. 4: Mean values for Likeability and Engagement scales

nice, polite words will be rated as more likeable. Besides, we have observed that engagement also benefits from the polite utterances. We did not find statistical significant differences in other scales, such as anthropomorphism, animacy, perceived intelligence, and perceived safety.

These results should be treated with caution since the size of sample (N=12) and the variety (all participants where students or staff from a university) are very limited. Further experiments are needed to extend these results to other conditions.

Acknowledgment

This research has received funding from the projects *Development of social robots to help seniors with cognitive impairment - ROBSEN* funded by the Ministerio de Economía y Competitividad (DPI2014-57684-R) from the Spanish Government; and *RoboCity2030-III-CM* (S2013/ MIT-2748), funded by Programas de

Actividades I+D of the Madrid Regional Authority and cofunded by Structural Funds of the EU.

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