FIDES: How Emotions and Small Talks May Influence Trust in an Embodied vs. Non-embodied Robot

(Extended Abstract)

Raul Paradeda*,†, Mojgan Hashemian*, Carla Guerra*, Rui Prada*, João Dias*, Ana Paiva*
*INESC-ID & Instituto Superior Técnico, Universidade de Lisboa, Portugal
†State University of Rio Grande do Norte, Brazil
(raul.paradeda, mojgan.hashemian, carla.guerra, rui.prada)@tecnico.ulisboa.pt,
(joao.dias, ana.paiva)@gaips.inesc-id.pt

ABSTRACT

Trust is known as a complex social-emotional concept and its formation is highly affected by non-verbal behavior. Social robots, as any other social entities, are supposed to maintain a level of trustworthiness during their interactions with humans. In this sense, we have examined the influence of a set of factors, including emotional representation, performing small talk and embodiment, on the way people infer trustworthiness of a robot. To examine these factors, we have performed different experiments using two robots, NAO and Emys, with and without physical embodiment respectively. To measure trust levels, we assumed two different metrics, a trust questionnaire and the amount of donations the participants would make. The results suggest that these factors influence significantly the level of trust. As, people tend to trust on Emys significantly differently depending on its facial expressions and making or not making small talk, and, people tend to donate differently to NAO when it is performing different emotional gestures and making or not making small talk. Furthermore, the trust levels were significantly different regarding the embodiment, comparing the experiments with Emys versus with NAO.

Keywords

Human Robot Interaction; Trust; Social Robotics; Emotion; Facial Expression; Small Talk; Physical Embodiment.

1. INTRODUCTION

As social robots are becoming a part of our daily lives, social robotics studies get major importance in order to make this integration the safer and more satisfactory as possible. Assistive robots are one example of social robots, whose actions could cause serious consequences to the people surrounding them [4]. Thereby, characterizing the factors that influence trust becomes a major concern in Human-Robot Interaction (HRI).

Thus, the combination of social robots and the concept of trust may raise an important question: is it possible for a human to trust a machine? As the confidence of humans in robots grows, they turn into more collaborative partners [1].

Appears in: *Proc. of the 16th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2017), S. Das, E. Durfee, K. Larson, M. Winikoff (eds.), May 8–12, 2017, São Paulo, Brazil.*

The preceding remarks have motivated us to develop a framework aiming at exploring factors influencing the trust inferred by a human towards a robot. In this framework, we designed different scenarios to compare and evaluate the level of trust under different circumstances. We argue that using a robot as a storyteller and a human subject as the recipient may reveal the influence of such factors. For instance, emotion, expressed either in facial expressions or body gestures, and making small talks prior to the interaction, as well as the embodiment may influence how trustworthy a robot could be to human users.

2. IMPLEMENTATION

To conduct this experiment we used the same methodology presented in our previous work [2]. The only difference is that in the previous experiment using the Emys robot, we used a symbolic animation engine based on CGI methods called Nutty Tracks [3], which provides the capability to animate a robot in a graphical language. While in the experiment using the Nao robot, Naoqi was used to start the animations and utterances.

3. THE STUDY

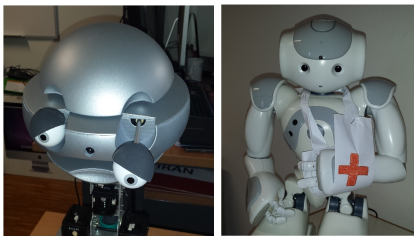
The study consists of an interactive design in which a robot complains to the participant about suffering from a mechanical problem and tries to get financial help from him/her to fix it (Figure 1).

Hypotheses

The three following hypotheses have been formulated:
H1- We hypothesize that starting a conversation with small talk would enhance the level of trust an individual has in the robot.
H2- We hypothesize that expressing sad emotion, while telling a sad story, would enhance the level of trust an individual infers interacting a robot.
H3- We hypothesize that the presence of the robot's body may influence the trustworthiness of the robot.

Scenarios

To measure the potential influences on trust, we designed four scenarios with specific characteristics:
S1 - The robot starts the interaction with small talk while expressing a sad face {ST_SAD},
S2 - The robot starts the interaction without small talk while expressing a sad face {NST_SAD},
S3 - The robot starts the interaction with small talk while



(a) Emys **(b)** Nao

Figure 1 Animation of the robot in the moment of showing the mechanical problem to the participant.

expressing a joyful face {ST_JOY},
S4 - The robot starts the interaction without small talk while expressing a joyful face {NST_JOY}.

Participants

The study was conducted in an isolated room within a random selection of students. In the first experiment, using Emys robot, a total of 42 subjects participated ($M = 24.9$; $SD = 4.85$; 11 females and 31 males). In the second experiment, using Nao Robot, a total number of 40 subjects participated ($M = 22.15$; $SD = 4.84$; 17 females).

4. RESULTS

4.1 Experiment 1: Emys

Within group analysis

A U Mann Whitney test indicated that there was no significant difference between the subjects before interacting with the robot (ST: $U = 54.5$, $p = .972$; NST: $U = 45.5$, $p = .732$; SAD: $U = 36.0$, $p = .29$; Joy: $U = 53.0$, $p = .622$). These results endorse that all the participants had the same presumption and feeling before interaction with each robot. Therefore, the possible difference in the robot perception (post-questionnaire scores) is due to the different variables, i.e. emotional representation and/or small talk.

Between group Analysis

A Kruskal-Wallis (K-W) test indicated that the four groups are significantly different regarding the two variables ($\chi^2(3) = 10.396$, $p = 0.015$).

Donation

A K-W test result indicated that there is no significant difference between the four groups regarding the donation amount ($\chi^2(3) = 3.397$, $p = 0.334$).

4.2 Experiment 2: NAO

Within group analysis

Results of U Mann Whitney tests indicate that there is no significant difference in the distribution of the subjects regarding the pre-questionnaire scores (ST: $U = 48.0$, $p = .880$; NST: $U = 39.5$, $p = .427$; SAD: $U = 46.5$, $p = .791$; Joy: $U = 36.0$, $p = .29$). Hence, all the subjects were under the same condition before interacting with the robot.

Between group Analysis

Multi-variate

In this experiment, the K-W test did not show any significant difference between the groups ($\chi^2(3) = 4.729$, $p = 0.193$). Hence, to further analyze the data we turn to univariate analysis by comparing each group separately.

Univariate

In this section we compare groups which have only one variable in common. This includes comparing the influence of emotional expression while the robot started the conversation with small talk (ST) vs. without small talk (NST). Also, comparing the influence of small talk while the robot expressed sad gestures (SAD) vs. joyful gestures (JOY).

First we compare groups differing in single variable by applying the U Mann Whitney non-parametric test. The only significant difference happened in case of SAD ($U(9) = 22.5$, $p = .038$), and for other groups no significant difference were observed (ST: $U(9) = 42.5$, $p = .571$; NST: $U(9) = 43.0$, $p = .596$; JOY: $U(9) = 40.5$, $p = .472$).

The preceding paragraph entails that JOY_SAD in ST form the same distribution, as well as JOY_SAD in NST. Hence, we can combine them and analyze the potential difference between making small talk and not making. A U Mann Whitney test indicates that there is a significant difference between the JOY_SAD groups in ST ($U(19) = 127.0$, $p = 0.048$) and the higher mean in the NST (81.6 vs 80.8) shows that participants tend to trust more in the NST, ignoring the gestures.

Donation

The K-W result shows that there is a significant difference in the donation amount among the four groups ($\chi^2(3) = 8.816$, $p = 0.032$).

4.3 Embodiment

Putting the studies together, which were similar in all dimensions except the robot, we can compare the influence of embodiment on the participants' trust level. We applied the K-W test on the eight groups (ST, NST, SAD, JOY corresponding to the first and second experiment). The results show that there is a significant difference between these 8 groups' trust level ($\chi^2(7) = 18.281$, $p = 0.011$). However, considering the donation amount, no significant difference was observed between these 8 groups ($\chi^2(7) = 12.596$, $p = 0.083$).

5. DISCUSSION AND FUTURE WORK

The trust level differed significantly in experiment 1, which endorses the influence of facial representation and small talk. Likewise, in the second experiment, the donation scores differed significantly among the four groups. And finally, when comparing both experiments, the trust scores differed significantly in case of embodiment. We conclude that the three hypotheses influence significantly the way people infer trustworthiness in robots.

Despite the promising results, some future steps are still required to perform. The first and foremost is increasing the sample size to increase more reliable results within subgroup analysis. On the other hand, the results showed that the perception of the emotional representations was not easily inferable. Hence, we intend to implement the facial expression and gestures in a more natural and believable manner.

ACKNOWLEDGMENT

We would like to acknowledge the CNPq (201833/2014-0) and UERN-Brazil. Also, this work was supported by national funds through Fundação para a Ciência e a Tecnologia ref. UID/CEC/50021/2013 and project AMIGOS (PTDC/EEISII/7174/2014).

REFERENCES

[1] J. J. Lee, W. B. Knox, J. B. Wormwood, C. Breazeal, and D. DeSteno. Computationally modeling interpersonal trust. *Frontiers in Psychology*, 4, 2013.

[2] R. B. Paradeda, M. Hashemian, R. A. Rodrigues, and A. Paiva. How Facial Expressions and Small Talk May Influence Trust in a Robot. pages 169–178. Springer International Publishing, Kansas City, 2016.

[3] T. Ribeiro, A. Paiva, and D. Dooley. Nutty tracks: symbolic animation pipeline for expressive robotics., 2013.

[4] A. R. Wagner. *The Role of Trust and Relationships in Human-Robot Social Interaction*. PhD thesis, 2009.