On the Importance of Posture and the Interaction Environment

Exploring Agency, Animacy and Presence in the Lab vs Wild using Mixed-Methods

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ABSTRACT

This work explores three concepts relevant to the study of human-robot interaction: posture, setting and evaluation methods. The first concept is the importance of a robot's posture on its perceived interaction affordances. Early findings suggest that the same robot presented in different postural arrangements may significantly impact the way the interaction is perceived. Second, there is growing evidence to suggest the importance of situating interaction studies in-the-wild. We observed that the environment an interaction is situated in strongly affects the outcome, an indication that experiments constrained to the laboratory may not reveal useful social aspects relevant to understanding HRI fully. Finally, in order to conduct in-the-wild studies, we argue that current practice of using single-strand methods may not be sufficient; we instead explore a mixed-methods approach to study the complex social and environmental interplay between the robot, the participant and the bystanders.

CCS CONCEPTS

• Human-centered computing → User studies • Human-centered computing → Empirical studies in interaction design • Human-centered computing → HCI design and evaluation methods

KEYWORDS

HRI; Mixed Methods; In the wild; Robotic artt

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1 INTRODUCTION

According to Jung et al. [1] there is a strong need for conducting studies that focus on exploring HRI in complex social settings where robots are increasingly being placed and are likely to appear more frequently in the near future. This need was also emphasised by Rahwan et al [2]. Museums are useful sites for such studies as identified by Silvera-Tawil et al [3] and Herath et al [4]. Silvera-Tawil et al [3] concludes that the context for which the experiments are conducted is important and speculated that participant bias might be reduced at an in-the-wild experiment compared to one conducted in a laboratory. However, this claim is yet to be validated as the experiments in their study were only conducted in-the-wild, and not in the laboratory setting as well.

1.1 Mixed Methods

Aly et al [5] stresses the difficulties in defining clear metrics and benchmarks for the different aspects of HRI, which could be helpful when wishing to compare different systems and avoid application-biased valuation when doing so. The Godspeed questionnaire developed by Bartneck et al [6] have been a popular post-hoc metric. Sim and Loo [7] describes it as a thorough method to develop a good overall evaluation score of the HRI in many contexts. However, they recommend combining the Godspeed questionnaire with psycho-physiological measurements to introduce a more objective measurement, as they find the Godspeed questionnaire to be subjective and thereby possibly biased. Vlachos et al. [8] state that it is important to understand how people perceive a social robot both prior and following the interaction. Furthermore, Andrés et al. [9] found it important to understand the setting where the interaction occurs and the features of the robot during the interaction. De Graaf and Allouch [10] found that both utilitarian and hedonic factors should be researched when looking at the acceptance of social robots. We propose that using a mixed-methods approach could be advantageous in this context which captures self-reported data with observational data to understand the interaction more fully.

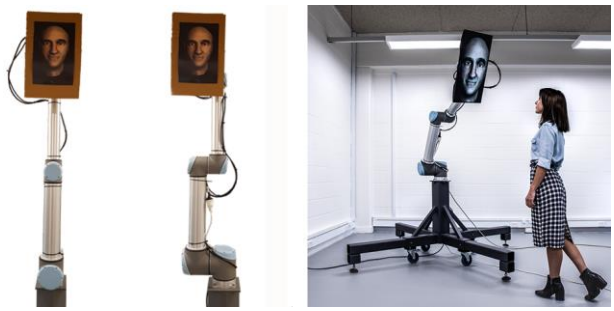

Figure 1: Two Postures. Left–Frontal, Middle-Profile and Right–Robotic art installation using the selected Profile posture in the lab setting.

1 EXPERIMENTS AND RESULTS

The interaction context was derived from a robotic art installation described in Kroos et al. [11], where an industrial robot arm mounted with a display monitor displays a virtual, interactive avatar. We used the UR10 robot (Figure 1) instead of the originally described Fanuc LR Mate robot.

1.1 In-the-Lab: Posture Study

Use of the UR10 allowed the robot to assume two different postures. The first we called the *Frontal* (Figure 1-left). In this posture the robot behaved more like the iconic Pixar lamp. In the other configuration, *Profile* (Figure 1-Middle) the robot behaved similar to the original art installation where the robot could "reach out" in a frontal approach. Four different movements were pre-programmed in loops, two based on the Frontal position and two based on the Profile position to mimic an 'exploring' robot (the attention system as described in the original work had yet to be implemented). We wanted to identify which posture generated a better interaction experience for the participant. We recruited 16 participants, 11 male and 5 females between the ages 19 and 50 (M = 24.4, SD = 7.6) in the laboratory setting (Figure 2-right). Each participant was only presented with two of the four movements due to balancing and after 'interacting' with the robot, they completed a version of the Godspeed Questionnaire [6].

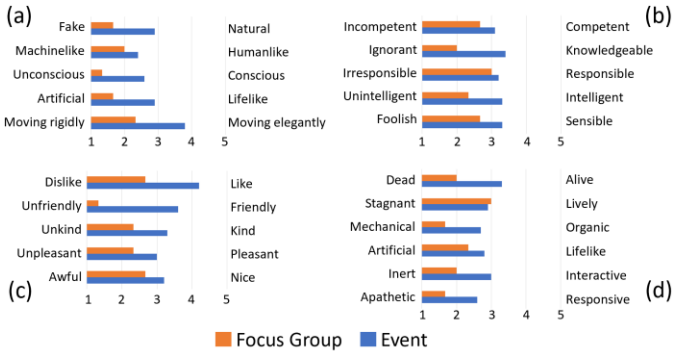

Figure 2: Average ratings. (a) Anthropomorphism (b) Perceived Intelligence (c) Likeability (d) Animacy Note: Perceived Safety excluded here.

Statistical analysis shows a significant effect of the position on the Anthropomorphism rating, $F(1, 30)$ 4.87, $p = 0.035$ but the assumption of multivariate normality was not met. However, we could identify a tendency that the robot in Profile position was perceived as more anthropomorphic, had higher animacy, was more likeable and perceived as more intelligent than in the Frontal position. This was also evidenced by comments from the participants, where one stated that they found Profile more friendly and one commented that it seemed more engaging when in Profile. Following the lab study, we devised a second set of experiments with the robot positioned in the Profile arrangement (Figure 1 – right). This grounding study highlights the importance of posture for designing interaction scenarios.

1.2 In the Lab vs In-The-Wild

The robot was positioned at a public networking event held at the university in a public space, and participants were recruited on-the-fly. The robot was again set up with looped pre-programmed movements. Participants were informed that the robot was an art installation soon to be installed at a museum. Participants were invited to freely interact with the installation. Afterwards, they completed the survey with five Godspeed questionnaires on a tablet. The experiment was then repeated in laboratory environment. Here participants were recruited 2 weeks prior to the study, and a focus group was conducted following interaction. 10 people completed the questionnaire at the public event, and 3 persons in the lab. Interviews and observational data were used to conduct a thematic analysis [12] in both experiments.

Quantitative data. When compared to the lab study, participants at the event rated higher on the four concepts: Anthropomorphism, Animacy, Likeability and Perceived Intelligence (Figure 2). The participants from the two studies seem to have rated the AH equally safe. The item with the most significant difference between the means was Unfriendly/Friendly, where the participants in lab found the robot unfriendly compared to the event participants in-the-wild. This may be related to the participants in the lab study spent far longer with in their interaction (20 min vs. 5 min). Also, there are fewer distractions in a laboratory setting, so participants had more time to focus on design features.

Qualitative data. We found 16 themes after conducting our thematic analysis on the video and interview data. Similar themes emerged between the two studies. The robot should have a correlation between the facial animations and the physical movement of the robot in order to create more powerful experiences. In both settings, the participants focused primarily on the robot's eyes and tried to gauge the object of attention. The laboratory group appeared to have preconceived expectations which was not observed with the study at the public event, probably because they had been recruited to participate in an HRI study, whereas the audience at the public event was unsuspecting and did not have time to develop expectations ahead of time. Therefore, context may influence participant expectations, which could shape their experience. While these are early results, it is clear that for the same robot, interaction experiences can be vastly different based on the interaction environment and context.

REFERENCES

[1] Jung, M. and Hinds, P. Robots in the wild: A time for more robust theories of human-robot interaction. ACM Transactions on Human-Robot Interaction (THRI), 7, 1 (2018), 2.

[2] Rahwan, I., Cebrian, M., Obradovich, N., Bongard, J., Bonnefon, J.-F., Breazeal, C., Crandall, J. W., Christakis, N. A., Couzin, I. D., Jackson, M. O., Jennings, N. R., Kamar, E., Kloumann, I. M., Larochelle, H., Lazer, D., McElreath, R., Mislove, A., Parkes, D. C., Pentland, A. S., Roberts, M. E., Shariff, A., Tenenbaum, J. B. and Wellman, M. Machine behaviour. Nature, 568, 7753 (2019/04/01 2019), 477-486.

[3] Silvera-Tawil, D., Velonaki, M. and Rye, D. Human-robot interaction with humanoid Diamandini using an open experimentation method. City, 2015.

[4] Herath, D., Jochum, E. and Vlachos, E. An Experimental Study of Embodied Interaction and Human Perception of Social Presence for Interactive Robots in Public Settings. IEEE Transactions on Cognitive and Developmental Systems (2017).

[5] Aly, A., Griffiths, S. and Stramandinoli, F. Metrics and benchmarks in human-robot interaction: Recent advances in cognitive robotics. Cognitive Systems Research, 43 (2017/06/01/ 2017), 313-323.

[6] Bartneck, C., Kulić, D., Croft, E. and Zoghbi, S. Measurement Instruments for the Anthropomorphism, Animacy, Likeability, Perceived Intelligence, and Perceived Safety of Robots. International Journal of Social Robotics, 1, 1 (January 01 2009), 71-81.

[7] Sim, D. Y. Y. and Loo, C. K. Extensive assessment and evaluation methodologies on assistive social robots for modelling human–robot interaction – A review. Information Sciences, 301 (2015/04/20/ 2015), 305-344.

[8] Vlachos, E., Jochum, E. and Demers, L.-P. The effects of exposure to different social robots on attitudes toward preferences. Interaction Studies, 17, 3 (2017), 390-404.

[9] Andrés, A., Pardo, D. E., Díaz, M. and Angulo, C. New instrumentation for human robot interaction assessment based on observational methods. Journal of Ambient Intelligence and Smart Environments, 7, 4 (2015), 397-413.

[10] de Graaf, M. M. A. and Ben Allouch, S. Exploring influencing variables for the acceptance of social robots. Robotics and Autonomous Systems, 61, 12 (2013/12/01/ 2013), 1476-1486.

[11] Kroos, C., Herath, D. C. and Stelarc Evoking agency: Attention model and behaviour control in a robotic art installation. Leonardo (2011).

[12] Braun, V. and Clarke, V. Using thematic analysis in psychology. Qualitative Research in Psychology, 3, 2 (2006/01/01 2006), 77-101.