LARPing Human-Robot Interaction

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ABSTRACT

In this paper, we report the first findings of recently initiated research on combining live action role-playing (LARPing) and human-robot interaction (HRI) research. The research aims to generate insights that can further both HRI research and LARPing practices. In a pilot study, we incorporated a soft robotic tentacle into a live action role-play (LARP). We found significant differences in how intelligent the robot was rated to be and how safe the interaction was rated to be in comparison with interactions with the robot in a classroom setting. Through our discussion of these preliminary results, we seek to introduce LARPing as a potential tool of HRI research and to reflect on what its benefits and drawbacks might be.

CCS CONCEPTS

• **Human-centered computing** → **Interaction design**; • **Applied computing** → **Media arts**; • **Computer systems organization** → *Robotics*.

KEYWORDS

live action role-playing (LARPing); human-robot interaction; soft robotics; robotic art

1 INTRODUCTION

Live action role-playing (*LARPing*) has recently been argued to constitute a novel resource for design research. In interaction design discourses, for instance, LARPing has been cast as an embodied research method, and a tool to leverage the physical and situated experience of designers [10]. Within this description, LARPing is understood as either a useful sensitizing activity prior to design practice or a testbed for investigating and iterating design concepts and prototypes. When using LARPs for research purposes, designers can themselves play the role of users or other people, or elements in the context of usage, or even the proposed technologies themselves. Because role-playing allows for moments of temporary identity transformation, LARPing can enable people to take on new perspectives and see things differently. This may facilitate empathy with marginalized points of view and lead to the discovery of important issues that were not identified initially [10]. By virtue of these and other aspects, it is likely that LARPing could possess certain advantages over existing user-centered research and design methods.

In this paper, we report the first findings of recently initiated research on combining LARPing and human-robot interaction research. The project is a collaboration between the two authors – a LARP designer and artist (Susan) and a soft roboticist and practitioner of robotic art (Jonas). The research aims to generate insights that can further both HRI research and LARPing practices. We investigate whether and how LARPing might be incorporated into HRI research practices. But we equally seek to understand, what demands that are put on a robot for it to function as an integrated and engaging element in a LARP. Hence, the work also extends recent research on soft robotics as an aesthetic medium [4, 5, 7, 8]. The pilot study, we present in this short paper, was designed to explore what some of the effects of LARPing are on human-robot interaction. Through an interaction experiment, we examine how encountering a robot in a LARP setting modulates people's assessment of the robot and their interactions with it. More specifically, the paper contributes research on people's experience of interacting with a soft robotic tentacle in a LARP setting versus in a non-LARP setting. Through our preliminary results, we seek to introduce LARPing as a potential tool for HRI research and to initiate a discussion on some of its benefits.

In relation to the workshop's focus on creative content creation for social robotics, the research presented takes the position that the content of human-robot interaction is co-created in and affected by its specific context. That is, the experience of interacting with a robot emerges in part through the staging of the robot, the atmosphere of the settings, the activities that precede the interaction, and the cultural context. Content creation therefore entails not just the programming or the design of the robot. It equally necessitates a considering of how specific contextual constraints affect or modulate the physical interaction and its qualities.

2 METHODOLOGY

In the pilot study, we incorporated two robots into a LARP. We used a between-subjects study design with two conditions - different participants interacted with the same robot in a LARP setting and a non-LARP setting respectively. For the LARP condition, data was collected at four runs of the same LARP that were a part of the art exhibition *The Shape of Things to Come: Technology, AI and Humanity* at Aoyama Gakuin University campus in Tokyo (Nov. 16 to Dec. 15 2019). Data for the non-LARP condition was collected during a visit to a class of students at Aoyama Gakuin University, in the same period. Susan gave a presentation on her work and had a brief discussion with the students about soft robotics. She presented the robots to them, and afterwards they were given time to interact with them if they wanted to. They interacted alone or in pairs, and were allowed to touch the robots.

3 MATERIALS

3.1 Robot

From the outset, we wanted to use soft robots for the experiment, as they fit well with the themes explored in the LARP (bodily intelligence, touching, how knowledge is obtained through the senses, how the body's affordances contribute to cognition). During our initial meeting, we experimented with and discussed different soft robots and possible sensors to use. We did not want the robot to be perceived as a prosthesis, but as an autonomous entity with whom a social relation might be established. Previous research has indicated that simple geometrically shaped actuated silicone structures can elicit such impressions, yet they are still open to many different interpretations [2], which we deemed would be beneficial to the LARPing experience.

We used two custom designed soft robots. The first of the robots (a group of bending and coiling soft actuators assembled in a group, which responded to sound), however, did not function properly during the LARPs. Hence, we only analyze data gathered about the second fully functional robot, a soft robotic tentacle (see Figure 1). The soft tentacle has a conical shape and three chambers for pneumatic actuation. When a chamber is inflated, the tentacle expands and bends towards the side opposite to the chamber. In previous studies [6] we have used a similar design and established that, despite its non-anthropomorphic shape, some participants treat this type of robot as a social actor when interacting with it, which is evinced by e.g. perspective-taking and speaking directly to the robot. The tentacle is cast in uncolored Ecoflex 0030 silicone and coated with talc powder to prevent lint and dirt from sticking to its surface. It is supplied with pressurized air via silicone tubing and actuated by three low noise electrical pumps (MITSUMI R-14 A213). Solenoid valves (Uxcell Fa0520D 6V Normally Closed) are implemented to facilitate the release of air. Two H-bridge chips (L292D) are used to drive the valves and pumps and the robot is controlled by an Arduino Pro Mini microcontroller.

We added a temperature sensor (DS18B20) to the tentacle as the only sensor. The temperature sensor is positioned so that it can come into contact with the palm, when the tentacle is held in both hands (see bottom image Figure 2). The robot is programmed so that preprogrammed expressive movement sequences are triggered when the temperature sensor is heated above a certain threshold through bodily contact with the hands.[1]

3.2 LARP scenario

We used the robots in a LARP written and facilitated by Susan. The LARP is in the *Nordic LARP* tradition, which emphasizes collaborative creation and unobtrusive rules. It incorporates elements from somatic practices and players do warm up exercises before playing (two short physical games, a group cohesion excercise, and somatic sense and exploration excercises). The scenario extends general interests of Susan's LARPing practice in simulating a different way of being, rather than having an emphasis on character and story development. Participants play sensing creatures that detect intelligence through touch and explore a room searching for signs of intelligence. In the players' introduction to the fiction this is described as follows:

This world is alien to you, this world in this room. You may have been to earth before, so you might have other experiences on this planet, but the objects in this room are completely new. You have been sent from another place, to investigate. The main way you investigate is through your senses, the most powerful being touch. You mission is to explore the objects here, and gather information about them, and especially if you think they are intelligent, and/or hold any special powers. You will report back to the members of

[1]A video showing two of these movement sequences is available at: https://youtu.be/Rq_-geG6N-s

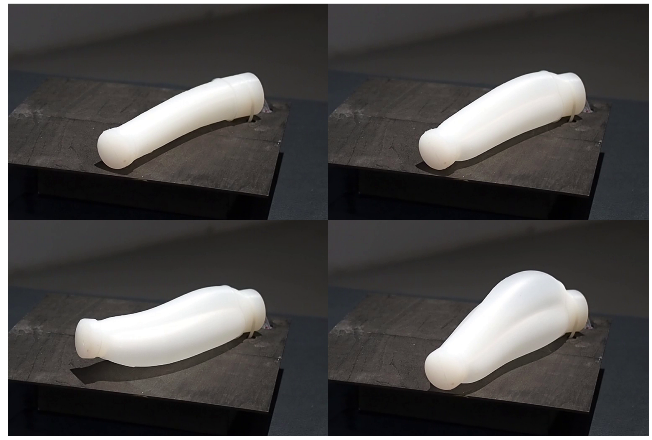

Figure 1: The soft robot performing one of its preprogrammed movement sequences. The soft morphology is approx. 24 cm long with the electronic and pneumatic control system placed offboard.

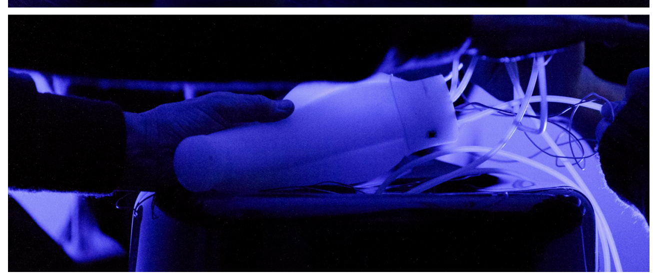

Figure 2: Photos taken during one of the runs of the LARP showing the soft tentacle and participants. In the bottom image the temperature sensor is visible (small black dot near the end of the tentacle).

your group through words, which become chants and poems. The words help others understand what you are encountering.

In the LARP, the two soft robots were staged on plinths with their electronics and pneumatics out of sight (Figure 2). Different objects fitted with pneumatic tubing were placed on similar plinths in the room. After the warm-up exercises and the introduction, the players created their characters for the scenario and played.

3.3 Data collection

Following interaction, we administered a dual language version of the Godspeed questionnaire series [1] in English and Japanese to participants. Godspeed questionnaires are validated self-reporting tools that have been used widely in studies to gauge people's general impression of a robot [12]. We chose to use the questionnaires for *likeability*, *perceived intelligence*, and *perceived safety*, as we hypothesized that these attributes might be rated differently by the people that encountered the robot in a LARP setting. In addition to questionnaire data, video recordings were made of the LARPs with a stationary camera and audio was recorded during the debrief sessions that followed each run of the LARP.
In this paper, we only report results of the quantitative analysis of questionnaire data. In future work, we plan to combine and compare these results with qualitative analysis of transcriptions of audio and video and our own notes written after each run of the LARP.

3.4 Participants

A total of 28 non-randomized participants completed a questionnaire following interactions with the robot. All participants gave written consent to participate and to have data collected for research purposes. Participants did not receive any compensation for their participation. Demographic data on participants is included in Table 1.

Table 1: Demographic data.

	Condition 1 - LARP (N=18)	Condition 2 - Classroom (N=10)
Age	M:35.0 SD:15.8*	M:22.7 SD:3.4
Gender (female/male/ prefer not to answer)	(9/8/1)	(8/2/0)
Robot interaction experience (yes/no)	(11/6)*	(7/3)

*:Data missing for one participant.

4 RESULTS

Table 2 (next page) summarizes the mean values of the responses obtained on the semantic differential rating scales together with statistics. Reversed scores for negatively worded questionnaire items (*Relaxed/Anxious* and *Surprised/Quiescent*) are shown, to make the data easier to read.
An internal reliability analysis across all conditions was conducted with resulting Cronbach's alpha values for likeability (0.73), perceived intelligence (0.73), and perceived safety (0.80) that give us sufficient confidence in the reliability of the composite data for attributes.
We used independent samples T-tests to compare the mean scores for the three primary outcomes. The assumption of homogeneity was tested with Levene's test of homogeneity for variances that was fulfilled for all primary outcomes.
No significant difference for likeability was found between the two conditions ($p=0.61$). The robot was perceived as significantly more intelligent in the classroom condition than in the LARP setting ($p<0.05$). Perceived safety was significantly higher for the LARP setting than the classroom setting ($p=0.02$).

5 DISCUSSION

The finding that the robot was perceived as significantly more intelligent in the classroom condition than in the LARP setting is consistent with previous work showing that the context can affect perceived intelligence scores [3]. A possible explanation for this result could be that the participants in the LARP got to interact with the tentacle for a longer duration and in smaller groups. This might have allowed them to better understand the robot's functioning. The classroom participants, on the other hand, might not have been able to fully deduce the robot's simple programming and therefor more inclined to attribute it capabilities which it does not possess and a higher score for intelligence. This effect would be consistent with results of previous studies that have shown a drop in perceived intelligence after interaction [9].
Another explanation for this result could be that the LARP setting makes users exert more effort to familiarize themselves with the robot than they otherwise would. In our experience, LARPers often become very engaged in the narrative and world that they construct together with the other players. Players may also feel that they have an obligation to participate actively as a part of the social contract entered into by signing up for the LARP. However, an increased familiarity could also result from the fact that in the LARP participants are not representing themselves but playing a character. This might make them feel more free to take risks in the interaction, as their actions involve less potential consequences to their identity and social standing. Finally, the specific fiction that we used in the LARP, where players are creatures searching for intelligence, might have made the LARP condition participants focus more on the robot's intelligence during their interaction. Consequently, they may have explored this aspect more and become aware of the robot's limitations resulting in a lower intelligence rating.
The result that perceived safety was significantly higher for the LARP setting than the classroom setting is consistent with the proposed explanation that the LARP participants were better able to understand the robot's programmed behavior and therefore felt safer during interactions with it. However, another explanation could be that the exercises and somatic practices of attunement to one's own body and the environment, that were part of the LARP, made participants feel relaxed and at ease. As a result of this, they may have rated their experience of the interaction with the robot more towards the right-hand side terms of the semantic

Table 2: Mean and standard deviations for the semantic differential scale rating questions and group and group standard deviations for each attribute.

Questionnaire/Question	Condition 1 - LARP (N=18)		Condition 2 - Classroom (N=10)		
	Mean	*Standard deviation*	*Mean*	*Standard deviation*	*p-value (T-test)*
Godspeed III: Likeability	**3.71**	**0.65**	**3.54**	**0.76**	**0.61**
Dislike / Like	3.78	0.81	3.60	1.08	
Unfriendly / Friendly	3.82*	1.02*	3.20	1.32	
Unkind / Kind	3.61	0.98	3.10	1.00	
Unpleasant / Pleasant	3.78	1.00	3.80	1.23	
Awful / Nice	3.56	0.71	4.00	0.82	
Godspeed IV: Perceived Intelligence	**2.66**	**0.78**	**3.28**	**0.75**	**0.05**
Incompetent / Competent	3.11	1.18	3.60	0.84	
Ignorant / Knowledgeable	2.44	1.38	3.30	1.34	
Irresponsible / Responsible	2.47*	0.87*	2.70	1.06	
Unintelligent / Intelligent	2.44	1.38	3.30	1.16	
Folish / Sensible	2.78	1.00	3.50	0.85	
Godspeed V: Perceived Safety	**3.35**	**0.93**	**2.47**	**0.89**	**0.02**
Anxious / Relaxed	3.53*	1.07*	3.00	1.34	
Agitated/Calm	4.00*	1.12*	2.70	0.82	
Surprised/Quiescent	2.53*	1.23*	1.70	0.95	

*: Data missing for one participant.

differential scales that make up perceived safety (*Anxious/Relaxed*, *Agitated/Calm*, *Surprised/Quiescent*).

That the LARP participants felt more safe when interacting with the robot, however, is interesting, as it suggests that LARPing could potentially be used as an element or priming exercise in human-robot interaction research. Encountering a robot in a LARP setting might allow people to interact more freely with it, without being overwhelmed by safety concerns.

6 LIMITATIONS AND FURTHER WORK

In this preliminary analysis, we have not sufficiently demonstrated that the observed difference effects are not due to other factors than experiencing the robot in a LARP setting. The differences could, for instance, be a consequence of different interaction times or smaller group sizes in the LARP, and not the LARPing experience per se. Based on our observations of the interactions, we estimate that the LARP participants indeed did have longer interaction times than the classroom participants. In addition to this, a T-test revealed that the two condition groups were statistically significantly different with regards to age (p=0.006) (see Table 1). This means that the observed effects could also be a consequence of a difference in age, but this needs to be tested in further statistical analyses.

Besides the limitations of our interaction experiment described above, there are also other more general methodological challenges for research that combines LARPing and HRI, which we will consider in future work. A potential issue is that even if a specific LARP might be regulated by a script, it is by definition not fully planned ahead and emerges through the collaborative efforts of the unique group of people that participate in it, when it is run. This means that each time a LARP takes place, it will be different. Hence, the ephemeral character of LARPs and the problem of preserving or properly documenting LARPs have also been discussed within the field of performance studies [11]. With regards to HRI research, this defining trait could pose a problem and make it difficult to incorporate LARPing. Most HRI research methodologies are anchored in social science or natural science epistemologies that value knowledge which is reproducible, generalizable, and prescriptive rather than the types of knowledge produced through efforts to understand singular, unique phenomena or through critical intervention (as can be found in some parts of the humanities, critical social science, and artistic research practices).

Taking this methodological challenge into account, we plan to broaden the scope of our future research to also encompass questions about whether LARPing might be used as an innovation tool to help researchers and users imagine new uses for robots in general or new uses for specific robots or novel technologies such as soft robotics. We are equally interested in if setting up LARPs that incorporate robots might be a way to facilitate the wider public's involvement in robot design research, in order to make robotics research more inclusive.

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