Remote Co-speculation with Design Probes for Envisioning Emotional Robotic Touch

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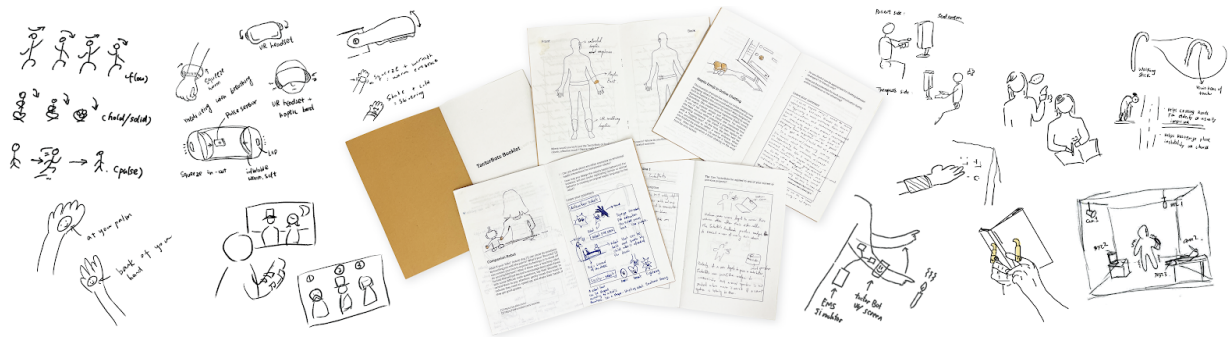
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Figure1. TactorBots Booklet: Design probes in the co-speculative exploration

ABSTRACT

This work is a co-speculative design exploration that investigates what the next generation emotional haptic system will be like and how it can be integrated into future daily life. We worked remotely with 13 designers, researchers, and artists with different expertise. To evoke a better awareness and understanding of emotional communication through haptic technology, we developed a toolkit, TactorBots, for designing emotional robotic touch. We also designed a custom booklet to further support the speculation and discussion, which includes example application scenarios with prompt questions and blank pages for documenting original speculative ideas. We ship the toolkits and booklets as probes to our participants, let them finish the design tasks according to instructions, and take several rounds of online meetings for generative discussion. Our goal for this exploration is to expand the design space of emotional haptics with robotic technology in the speculative future.

KEYWORDS

Emotional Robotic Touch, Co-speculation, Design Exploration, Design Probe, Design Toolkit, Research through Design

BACKGROUND AND MOTIVATION

As robots become increasingly ubiquitous and engaged in social interaction, it will be necessary for them to have the capability of emotional expressions through a full range of communication channels, which includes touch. Previous psychology research from Hertenstein et al. showed that humans could convey distinct emotions (i.e., anger, fear, happiness, disgust, love, gratitude, and sympathy) through touch alone [1-2]. Since then, a growing interest in the psychology area of emotional signals in touch has sparked many investigations on the emotional communication capability [3-6] and specific tactile features [5-7]. Inspired by those findings, an increasing number of Human-Computer Interaction (HCI) and Human-robot Interaction (HRI) researchers started to explore the possibility of recreating those emotional haptic stimulations with artificial technologies. Past works include developing affective agents [8-11], programming professional robots [12-15], designing expressive haptic devices [16-19]. Researchers have explored the use cases of remote mediated touch [20], notifications [21], virtual reality [22-23], and movie experiences [24]. Our previous work also indicates that the "otherness" of robotic touch can broaden the design possibilities of emotional communication beyond mimicking interpersonal touch [25]. By using the emotional haptic design, we will have a great potential to create more meaningful, connecting, and engaging

interactive experiences [26]. As a starting point, this work explores the design space of emotional robotic touch on what the next generation emotional haptic system will be like and how can it be integrated into everyday scenarios?

To answer these questions, we are collectively speculating about the future of emotional robotic touch with a group of potential users and stakeholders. As defined by Wakkary et al. [28], "co-speculation is the recruitment and participation of individuals with particular backgrounds who are well-positioned to actively and knowingly speculate with us in our inquiries in ways that we cannot alone." The aim of our co-speculation is to open the research inquiry to participants with diverse backgrounds. We invited both experts and non-experts. More specifically, our 13 co-speculators are researchers in haptics, human augmentation, HRI, well-being, textile, and cybersecurity; designers in new media and interactive installations for museums; and artists in AI and performance art. As emotional design is a mature theory in the designer community, expressive interaction can be intuitive for artists, and emotional haptics has great potential to enrich the experiences in other research fields, we believe those fresh eyes will speculate through a diverse perspective while generating ideas that are highly situated to their expertise.

Figure 2. TactorBots Toolkit: Design props for experimenting the perception and interpretation of emotional haptics

OUR APPROACH

Co-speculation on emotional robotic touch can be challenging as the capability of communicating emotions through touch is yet well-known. At the same time, the robotic touch sensation can also be alien to people [25]. It is hard for the participants to imagine how they could perceive the tactile sensations and interpret the emotional messages until they try it on their skin. Thus, we developed TactorBots, a design toolkit for exploring emotional robotic touch (Fig.2). It comes with a set of wearable tactor modules that render servo-driven force feedback coupled with a web-based software application. Each hardware module is specifically designed to perform one or two target social gestures (i.e., pat/hit, push, rub, shake, squeeze, stroke, and tap) commonly used in interpersonal affective interactions [1-2]. Our specialized web-GUI enables users to easily control and modify different robotic tactile behaviors and store or export the touch settings to implement in their own applications. Inspired by the bespoke booklets method for co-speculation [27], we designed the TactorBots Booklet (Fig.1). It includes several examples of use cases of TactorBots and speculative ideas on emotional robotic touch. Co-speculators are asked to provide comments according to prompt questions. In the blank pages, they need to write down their original speculative ideas with sketches. As "experiences and insights shared, emerged from lived experience during the study" is an important aspect of co-speculation [28], we ask our participants to interact and live with the probes and take the tasks based on their own pace.

Our co-speculative exploration has three main stages, which are carefully designed to familiarize co-speculators with the emotional robotic touch and progressively provoke their creativity. After receiving the package of TactorBots and Booklet (sealed in an envelope), we schedule the first meeting. *(1) Pre-study Interview:* a semi-structured interview on zoom for learning about the participant's area of research or design practice and related experiences. We also ask them to provide assumptions about how emotional haptics can be implemented in future life. We set this as the baseline of the brainstorming process. *(2) Expressive Haptic Storytelling and Interview:* a design task to familiarize co-speculators with emotional haptics. After learning how to use TactorBots, participants are asked to design emotional haptic cues to enrich a story and save the haptic patterns according to the guidance. In the second zoom call, we collect their feedback on TactorBots' capability and usability and suggestions for the next version of robot design. We then ask about their robotic touch design experiences. Specifically, we would like to know their behaviors, metaphors, and reactions when designing each touch pattern. Again, we ask them to brainstorm the future applications of emotional robotic touch. *(3) TactorBot Booklet and Generative Discussion:* Co-speculation with custom booklet. Finally, the participant is allowed to open the envelope and take the booklet out. The booklet has two sessions: *"Applications for TactorBots"* and *"Future Applications for Emotional Robotic Touch."* For each session, we provide three example scenarios and two blank blocks. The example scenarios are presented with sketches, brief descriptions, and prompt questions for collecting comments. They are designed for sharing our ideas with co-speculators to start the conversation. They also work as references or precedents to encourage brainstorming. Between the two sessions, there is a body map for collecting the appropriate placement of the robotic touch. After finishing the booklet, we arrange the generative discussion between the participant, our lead researcher, and two senior researchers. In the meeting, we go through the booklet context page-by-page. Instead of an expert interview, it is more about sharing experiences, ideas, inspirations, and exchanging insights based on the new inquiries emerging in the conversations.

REFLECTION

Our design exploration is still in progress. By the time of this submission, we have all the participants finished the 2nd stage task, and half of them finished the booklet task. Many new ideas have already emerged during our current study, such as "choreography tactilizer" or "remote partner" for dancing, "vulnerability communicator" for informing data privacy in spaces, "listening robot" for dairy companion, "Haptic Murder Mystery" for entertainment. The stage design in our exploration can indeed evoke co-speculator's creativity progressively. In the first zoom call, the baseline assumptions always lay in traditional use cases such as remote mediated touch or therapeutic interactions. In the second call, many participants said the robotic haptic cues rendered by TactorBots were unique and surprisingly expressive. They started to speculate with more specific concepts on emotional haptics. In the third zoom call, we found every co-speculators' comments and original ideas turned out to be more creative while having more in-depth considerations, especially when we discussed their motivations and inspirations. While the speculative results in our work can be expertise-situated or even personal to each participant, we believe those insights can be meaningful and inspiring for our community. After all of the participants finish the co-speculative exploration, we will create a digital gallery for the booklet content. We also plan to host a panel session that invites all the co-speculators to discuss their experiences and reflections. Based on all the results in the co-speculation, we will propose new avenues in the design space to guide researchers, designers, and artists in exploring the future possibilities of emotional robotic touch.

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