Designing wearable interactions through playful on-body explorations

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Abstract

This workshop proposal aims at provoking novel ways for full body interaction with interactive soft materials. Building on learnings from previous experiences on playful interaction with soft materials as a starting point, we focus on experimenting with full body interactions. We apply embodied design methods from soma design and material-led interaction design research. Together with the participants, we want to investigate the role of material characteristics in the interplay with body, movement and technology. We expect that the provided methods will foster novel full body material explorations which will be presented and documented at the end of the workshop. We aim to extend the group of researchers being aware of the role of material characteristics in playful interactions of soft materials.

Keywords
Embodied Interaction, Soft Technology, Playful Interaction

1. Introduction

E-textile design research combines domains from textile and technology development and contributes significantly to material related research in HCI. Researchers employ new methods to design embodied experiences and to connect with users in a playful manner [1], [2]. For instance, e-textiles guide participants to interact with various materials in new modalities [1], [3]–[5] and to communicate bodily experiences through novel frameworks or media [2], [6]. In a previous interdisciplinary online workshop, we explored the role of materiality in playful interaction with soft materials at TEI '21 conference [7]. The workshop aimed at learning about how participants engage in playful ways with soft materials - with and without added technology. In this workshop, the materials' agency was the main source of playfulness, and the various characteristics of soft interactive materials gave rise to play scenarios. In our current workshop-proposal, building on our previous findings, we aim to explore interactive soft materials and their playful characteristics to trigger new types of interactions through focusing on the body as an experimental territory. We propose a workshop that brings soft materials into alternative, unusual and, beyond all, ludic interplay with the body, to explore new whole-body interactions with textiles and e-textiles. We aim at provoking new ways of bodily interactions, that combine textile with technology towards a playful interactive engagement with materials.

Our aim is to focus on the exploration of new ways of full body interaction by using a tubular and circular soft probe in a physical workshop setting. By providing materials in bigger size and shape, we provoke the participants to involve full body and large movements in their interaction with the material.

Our previous workshop, using video-conferencing tools resulted in limited body movements mainly focusing on the upper body interaction to fit the screen frame. The added technology was limited to the smartphone or other simple technology simulations, which were not embedded fully in the soft material and therefore degraded the characteristics of the interactive material. In our current workshop, we aim at exploring playfulness with soft materials, where the soft characteristics of the materials would be augmented with embedded technology such as light, sound or vibration - together with the participants in the shared space. Our idea is to introduce methods that allow the participants to explore bodily interactions with a wearable soft probe on the body. Body movements (micro or macro) would be a driving force for an interplay between body and wearable item, a link between the physical and the digital worlds.

Our goal is to better understand how to design wearable interaction, in this case through playful on-body explorations, while answering the following questions:

- How can body movement become triggers to new types of play(ful) on-body interaction with soft wearables?
- What is the role of material agency in designing interaction on the body?
- How can body and material co-become, collaboratively act in a playful manner?

2. Background

This workshop involves the research about e-textiles on the body, material related interaction and bodily interaction frameworks. Some of those have been applied in the previous workshop at TEI 21 "Design for Playfulness with Interactive Soft Materials" [7], and the learnings are the basis for this workshop proposal.

Bergström et al have introduced the characteristic "becoming" of interactive materials: soft materials that change shape and appearance by property and technology in micro and macro level, and their traces of use [8]. We extend this notion with the body as a part of a shape changing component, therefore proposing a "co-becoming" experience through whole body experimentation.

The material turn in HCI has initialized the understanding for material related interaction and brought a focus on materials' characteristics as drivers for new interaction scenarios [9], [10, p. 34]. From the perspective of a material designer, this has not yet been researched to its extent: Researchers introduce different concepts of material related interactions which we aim to contribute to. On the other hand, while material designers focus on the material, they often neglect the whole-body experience, and generally work in a more fragmented way with various senses (touch, vision, sound, etc.).

2.1.　　E-textiles on the body

E-textile materials on the body are mostly explored in the fields of performance costumes and technical applications in sports, wellness or safety [11], [12]. Other examples of everyday tech-garments are therapeutic light wearables, providing mobile light therapy [13], [14].

The tactility of the interactive materials could be explored more in depth. For example, not using textile only as a carrier of technology but also make use of textiles' characteristics in the interaction concept.

In our workshop, we will invite the participants to play with larger textiles (tubular and circular) on the body to reflect on the interplay of textileness, closeness, tactility and playfulness related interactive features, and how material-led interactions (not only technologies) can be integrated with the soft materials (e.g. elastic, translucent, or lightweight textiles).

2.2.　　Material-led interaction

In the shift of the "material turn" in interaction design, Robles and Wiberg mention ubiquitous computing, tangible interactions, and computational materiality as strategies to relate the full integration of the digital and physical [9]. Other researchers argue to see the computer as a material and call the combined interfaces "computational materials/composites" [16], [17].

Bredies and Gowrinshenkar have explored and discussed material led interactions based on the textileness of e-textile objects such as "stretching, folding, piercing" and "turning inside out, rolling up, and stuffing" [18]. They stress for a material-related interaction design process. Tholander et al [19] highlight the importance of the agency in interactive novel materials through underlining "how creativity emerges in the situated interactions between designers and their materials." Winters refers to material-led design thinking through focusing on the importance of embodied and speculative experimentation in designing wearables [20]. By following these approaches, we will use material-methodological strategies to involve the participants and the material properties of the textiles by manipulating them in a playful manner. Thus, we (textile and our bodies) "co-become" hybrid entities.

2.3. Bodily interaction framework

Applying the theory of somaesthetics [22] to the practice of interaction design, relations between designed interface and bodily engagement with a designed object are described. According to Höök, Somaesthetic Design could help to "improve on all connections between sensation, feeling, emotion, and subjective understanding and values" [3] and therefore can provide a more holistic understanding on interaction design.

Beyond the somaesthetic approach that requires in-depth preparation of the design team and ongoing engagement with their inner lives [21], we strongly draw our practice on embodied design methods, particularly for the ideation process [5]. In doing so, it becomes possible to create new interactions from bodily activities, through/with/on the body. Other research has revealed that designing wearables and exploring materials on the body has an impact on the use context and on meaning-making [23].

Inside this situatedness and process, our embodied approach for the proposed workshop enables participants to engage with (un)known materials and shapes in a playful way, and through that, to (mis)use these materials to (re)design interactions enhanced by technologies.

3. Results: "Design for Playfulness with Interactive Soft Materials" -workshop

In the previous workshop, we had 16 participants from different fields in HCI (computer science, interaction design, e-textile design). Prior to the workshop, each participant analyzed three soft materials based on sensory perception (figure 1).
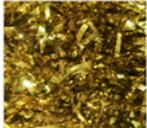
For task 1 (Table 1), everybody chose one material as "the most playful" and described the reasons with help of the PLEX-framework [2].

Table 1
Tasks previous Workshop

Task	Description
1 Material Explorations	Choose three soft materials, how you perceive them and what kind of playful aspects they have.
2 Material Selection	Which material is most playful and why?
3 Soft Tech Material Exploration	Team task after "Sensitizing-Labs" with test person, observer and interviewer.
4 Ideate with tech-enhanced soft material	Creation of a playful experience interaction cycle.

Task 2 was a group work done by three people in each group, derived after the "Sensitizing Labs" [1]. One was the test person, playing with the material (figure 2-4), one was "the interviewer" posing the given questions, and one was the "documenter" taking written notes. The final assignment was to create an individual interaction with the chosen material and tech, again using the PLEX set of categories to describe the playful experience.

Figure 1: Worksheet for analysis of soft material

Figure 2: Head-interaction with soft material

Figure 3: Light added to soft material, head-interaction

Figure 4: Leg-interaction with technology augmented material

In total, 15 final designs were gathered focusing on different body interactions: 5 whole-body interactions and 10 upper-body interactions (including head and fingers/hands).

The PLEX-framework was only filled in for task 2 and 3 by seven participants. They shifted from analyzing material properties to exploring interactive experiences with them. Qualitative results concerned mostly the properties of materials. Main finding was that elastic and thin, flexible material in combination with high- or low-tech actuation (vibration or air) invite to play with the material. Moreover, strong elasticity was perceived as a technological characteristic. One participant said: "material with many details/tentacles is more inviting than "clean" shapes, this features the quality of texture that can enhance interest and curiosity. Due to the workshop being online during the Covid-19 pandemic, the participants were limited to materials they had close-by, for tech add-on most of them used their phones which changed the properties of the material with an imbalance of weight, which often destroyed the playfulness. Also, due to attending the workshop online through their computers, participants mostly restricted themselves to work with their upper bodies only, although we tried to encourage them to stand up and explore the materials with their whole bodies while using the space they were situated in. One of the crucial insights from our first workshop is the size of a material. We documented a range of interactions: due to size of the individual materials, the spatial volume of the movements was very different. Additionally, the manifold properties of soft materials, in particular textiles, make it worth exploring how much technology is needed, moreover, when the body can be the actuator. We learned that the PLEX-method may be too complex and focused on too many aspects, including negative experiences. In contrast to that, other approaches to understand playfulness in adults [24] and children [25] draw on positive emotions and outlines that are connected to a state of mind. Furthermore, it makes action and reflection easier instead of framing them with negative aspects.

4. Workshop

We propose a workshop that aims at exploring bodily interactions with soft materials applying methods from embodied-design and playful interaction. To bring the body into the center of ideation and experimentation with materials, we will apply embodied methods, such as body-storming as the

main activity of the workshop through first-person [26] and third-person perspectives. Moreover, for exploring the playfulness of these bodily experiences, we adapt and extend "LevelXplore" method [27, pp. 131–132], and challenge the participants by answering the following questions:

1. Look: look at the material from outside and define
2. Interact: interact with the material and define
3. Explore: explore the material through your body: what can it do?
4. Manipulate: what can the material become? - with technology and the body
5. Perform: show the playful experience to the others/document as a movie
6. Reflect: reflect designing wearable interactions through playful on-body explorations/body-maps

We provide tubular and circular textiles in different elastic or light-weight variations for the participants, tools and simple actuators (e.g. light, vibration motors) and sound simulators (e.g. bells or sequences). We choose materials that are easy to integrate with the fabric, to keep the barrier low for non-tech or non-textile affine participants.

In addition to theoretical and practical input from our side (e.g. on design ideation methods, on power of textile materials, or an overview on wearable shapes), the participants will start with defining the given material by looking at it and afterwards interacting with it (Phase 1-2). After this analyzing and defining phase, they pass to an explorative stage to create ideas for playful interactions through embodied design ideation methods (Phase 3).

The next task will be to consider how this material shall be changed with high- or low-tech manipulations (e.g. embedding actuators like light, sound or vibration or changing the appearance and mechanical property of the textile by cutting, painting etc.) (Phase 4).

Next input will be a physical exercise to open the idea to bigger movements and novel forms of interaction. Participants will work on realizing their ideas with the material, documenting them with video or photo and presenting their outcomes to the group (Phase 5). Later they will reflect about new insights (Phase 6).

We expect to gain results that are body related, as the provided textile is already wearable and because of the exercises activating the body as a whole. As this is an onsite workshop, we think that more feasible actuators provide better integration of tech and textile to keep its soft characteristic.

To discuss, and later analyze, the process, we plan to apply the "five lenses of play" [25]. This framework focuses on the 1) structure and 2) forms of play, its 3) stages and the 4) resulting experience, and 5) how it emerges. Using these 5 lenses can provide tools and perspectives that support design decisions and evaluation of interactive outcomes. Methods we discussed to apply are primarily taken from the performing arts and embodied design, to engage participants in bodily activities and designing with/on the moving body. See table 2 for details.

The workshop addresses participants that are related to fields for example HCI, performing arts and e-textiles design research, no e-textiles knowledge required.

Table 2
Workshop Schedule

Time (CET)	Preliminary schedule actions
9.30-10.30	Introduction and Check-In with the participants, Task 1-2 (Look & Interact) - Defining the material.
10.30-12.00	Introduction to body-storming methods, using with provided materials (group) - Task 3 (Explore)
12.00-13.00	Lunch Break
13.00-15.00	Exploring playful aspects of technologies (individual or small group) and low-fi prototyping - Task 4 (Manipulate)
15.00-15.30	Coffee
15.30-16.30	Preparation of performance/ video documentation of the final results
16.30-17.30	Sharing playful experiences through performance/ video, and reflections

Possible materials: 5 tubes 50cm diameter (undyed cotton), 5 circles (undyed cotton) we prepare, LittleBits Stem Kit, batteries 9V, padding/sponge (motivate squeeze), glueable loop tape, poppers with tool, white duct tape, safety pins, projector, speakers (portable small with audio cable).

5. Discussion

In this workshop, we focus on the design of on-body interactions based on a given, specific wearable probe and provide a defined set of technology to be added. This will guide the design process to be inclusive of people of all backgrounds and the workshop to be results-oriented.

Having the activity conducted onsite, we have the chance to create an atmosphere for the group where participants feel safe to play and explore materials with their bodies through provided examples and samples. With body-storming and methods from the performative arts sphere we extend the comfort zones of the participants and get them out of the sitting position, to explore materials, body movements and their playfulness. Moreover, the interactions between participants during the workshop may lead to novel and playful multi-user soft wearable on-body interactions.

We expect to learn about how body movements trigger new types of playful on-body interactions with soft wearables, about the role of the materials' agency with or without technology and how the body and material co-become a hybrid entity in a playful manner. We aim at publishing the learnings from the workshop as a report. Compared to the previous workshop, in this workshop we can communicate more directly with the participants onsite which will lead to a stronger engagement with body and materials. We hope to raise the awareness of the role that the material characteristics play in bodily interactions and the interest to create a network of researchers/practitioners to share knowledge and/or collaborate in future research.

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