An Experiential Mapping of Tactile and Affective Fabric Experiences

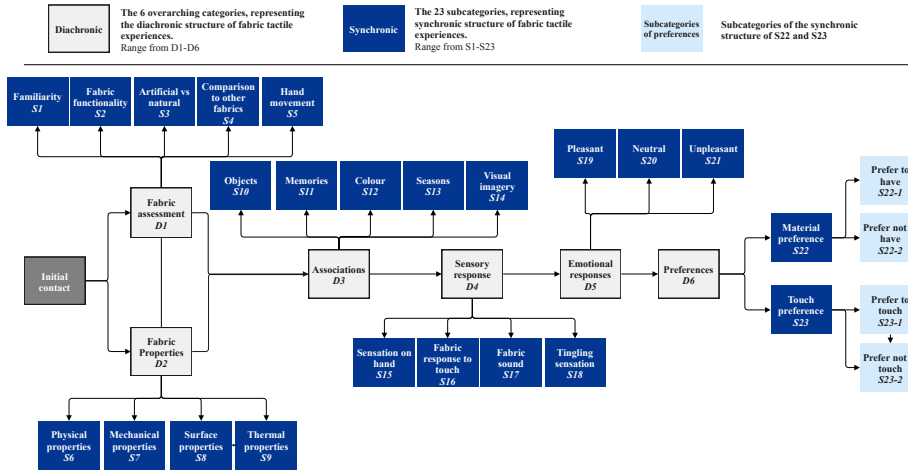JING XUE, University College London Department of Computer Science, UK

Fig. 1. Diachronic and synchronic structure of fabric tactile experiences, starting from the initial contact with the fabric and unfolding over time. We identified 6 overarching diachronic categories (D1-D6), and 23 subcategories (S1-S23) with additional branches in S22 and S23 for material and touch preferences.

The quality of a fabric product, such as a garment, is often judged by consumers and designers based on their tactile perception and affective responses. These responses can influence purchasing decisions, making it essential to consider them when designing interactive digital experiences for fabrics. Communicating tactile perceptions and affective responses of textiles could be a valuable design tool for textiles and fashion designers. However, there are currently challenges in communicating these experiences due to a lack of comprehensive understanding of fabric experiences. We used a mixed-methods approach to understand users' tactile and affective experiences towards fabrics, combining Micro-Phenomenological Interviews and questionnaires. We identified six overarching categories and 23 subcategories representing the diachronic and synchronic structure of users' fabric tactile experiences. Our study showed that fabric tactile experiences involve a wide range of experiences associated with fabric assessment, properties, and sensory responses, as well as affective responses, associations, and preferences. To facilitate a dialogue between designers and users, we developed a tool called FabTouch to represent user-derived tactile and affective experiences. This tool can be used in facilitating communications of design ideas between design experts and users.

CCS Concepts: • **Human-centered computing** → **Empirical studies in HCI**; **User studies**.

Additional Key Words and Phrases: Fabric; Touch; Tactile Experiences: Affective Responses; Diachronic and Synchronic Experiential Mapping; Multisensory Experiences.

1 INTRODUCTION

Consumers and designers often make initial judgments about a textiles product's (e.g., a fabric or a garment) quality based on how it feels to them, i.e., by their tactile perceptions and affective reactions [10, 14, 16]. Previous work from brain research has shown that when people touch an object featuring an affective experience (i.e., comfort, confident), the brain associated with emotion is more activated than their sensory brain [17]. Essick [2] also showed that different materials were reliably rated as pleasant based on different rates of touch. Their results highlighted that the affective responses associated with touching an object can have a profound impact on human perception. Therefore, when developing interactive systems for textiles in the digital domain, it is important to consider both the tactile perception of textiles and affective responses.

However, one of the current challenges in developing interactive systems for textiles is the lack of a comprehensive understanding of tactile perception and associated affective responses [1, 11, 12, 14]. Although recent HCI research has shown a strong interest in communicating and conveying emotions through touch (e.g. [3, 6, 12]), research on tactile perception and the associated affective responses of textiles is still in its infancy [16].

Using a mixed-methods approach that combines Micro-Phenomenological Interviews (MPI) with quantitative methods, our work addresses the aforementioned gaps. In our work, we explore the temporal and experiential mapping of fabric tactile experiences, identifying six overarching categories and 23 subcategories that reflect their diachronic and synchronic structure. We show that fabric tactile experiences extend beyond tactile experiences related to fabric physical properties, and that they go beyond the perceptual information derived from surface texture. They include a wide range of experiences associated with fabric assessment, properties, and sensory and emotional responses.

2 TOWARDS DESIGNING AFFECTIVE TEXTILE EXPERIENCES

Recent studies have shown that touch can elicit emotional responses and activate brain regions associated with emotions more than those associated with sensory responses [17, 18]. This has led to an increased interest in textiles and their tactile and affective responses in the field of Human-Computer Interaction [1, 6, 8, 9, 13, 16]. However, while some studies have focused on the mechanical or electrical interactions with bodies or environments [6, 13], only a few have examined tactile perception or its' associate affective responses with textiles [8, 16].

Further research is needed to examine users' tactile and affective responses to textiles. This could lead to the development of new tools and interfaces that will allow more effective communication between users, experts and designers in the field of textile design and Human-Computer Interaction, enabling better capture and communication of fabric experiences.

3 MAPPING TEXTILE EXPERIENCES

In our work, we used 9 cotton fabric samples, namely Heavy Drill, Flannel, Buckram, Organza, Velvet, Voile, Calico, Muslin and Twill (as cotton fabrics are extensively utilized natural textiles globally, such as T-shirts, shirts, and jeans [5]), we examine their tactile perception and affective experiences. We aim to understand users' affective responses and tactile perception of textiles. In our work, we explored the multi-structure of tactile experiences with fabrics

using qualitative and objective measurements. Through Micro-phenomenology Interviews technique, we analyzed the diachronic and synchronic structures of users' experiences with nine fabric samples. The diachronic structure offers insights into how participants' tactile and affective experiences unfold over time, while the synchronic structure provides insights into the specific configuration of those experiences. We then constructed an experiential mapping over time to illustrate the richness of these experiences (as show in Figure 1).

In addition, our results show that users' tactile experiences with fabrics extend beyond objective measurements of fabric properties, such as physical, mechanical, surface, and thermal properties [7]. While previous studies on surface tactile perception of fabric highlighted dimensions such as roughness, compression and warmth [4, 15, 19], our findings suggest that fabric surface tactile experiences are more strongly correlated with flexibility, fluffiness, regularity, and wetness.
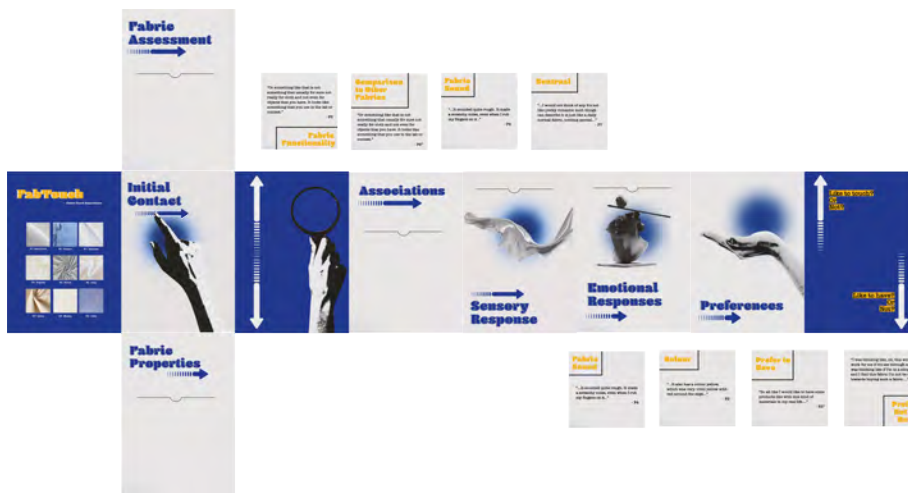

Fig. 2. The unfolded FabTouch tool with example cards for the fabric touch experiences, including exemplifying expressions from participants, linked back to the cotton fabric (F1-F9).

4 THE FABTOUCH TOOL

To enable a dialogue between designers and users about these experiences, we developed a tool called FabTouch that represents user-derived tactile and affective experiences. It is a tangible representation of the novel insights into fabric tactile and affective experiences that we have gained. The tool unfolds like an accordion book and is structured based on the diachronic and synchronic structure of the identified fabric touch experiences, as depicted in Figure 1. Users can engage with the included content in a stepwise manner, choosing from six overarching diachronic structures and 23 synchronic subcategories as they unfold the tool.

To present users' experiences in detail, we have created cards that sit in the accordion book pockets, with each pocket representing one of the six diachronic/temporal categories. The pocket cards contain descriptions of the synchronic categories, which include specific details on the configuration of the experience, as well as example expressions (i.e. verbatim quotes) from our participants, linked to example fabric samples in that category.

5 CONCLUSION

As a result of our work, we suggest that fabric tactile experiences are rich and complex phenomena that involve fabric assessment, fabric properties, and sensory responses. Additionally, we found that fabric tactile experiences are highly affective in nature, with users' affective responses encompassing more than just emotional responses, but also associations and preferences. With our tool-FabTouch, we bridge the gap between the design of physical and digital fabrics by providing a detailed understanding of how users interact with fabrics on a tactile and affective level.

ACKNOWLEDGMENTS

REFERENCES

[1] Douglas Atkinson, Sharon Baurley, Bruna Beatriz Petreca, Nadia Bianchi-Berthouze, and Penelope Watkins. 2016. The tactile triangle: a design research framework demonstrated through tactile comparisons of textile materials. *Journal of Design Research* 14, 2 (2016), 142–170.

[2] Greg K Essick, Anuj James, and Francis P McGlone. 1999. Psychophysical assessment of the affective components of non-painful touch. *Neuroreport* 10, 10 (1999), 2083–2087.

[3] Yuki Hashimoto and Hiroyuki Kajimoto. 2008. A novel interface to present emotional tactile sensation to a palm using air pressure. In *CHI'08 extended abstracts on Human factors in computing systems*. 2703–2708.

[4] Mark Holliins, Richard Faldowski, Suman Rao, and Forrest Young. 1993. Perceptual dimensions of tactile surface texture: A multidimensional scaling analysis. *Perception & psychophysics* 54, 6 (1993), 697–705.

[5] Gai Huang, Jin-Quan Huang, Xiao-Ya Chen, and Yu-Xian Zhu. 2021. Recent advances and future perspectives in cotton research. *Annual review of plant biology* 72 (2021), 437–462.

[6] Gijs Huisman and Aduén Darriba Frederiks. 2013. Towards tactile expressions of emotion through mediated touch. In *CHI'13 Extended Abstracts on Human Factors in Computing Systems*. 1575–1580.

[7] S Kawabata and Masako Niwa. 1991. OBJECTIVE MEASUREMENT OF FABRIC MECHANICAL PROPERTY AND QUALITY. *International journal of clothing science and technology* 3, 1 (1991), 7–18.

[8] Jin Hee (Heather) Kim, Kunpeng Huang, Simone White, Melissa Conroy, and Cindy Hsin-Liu Kao. 2021. KnitDermis: Fabricating Tactile On-Body Interfaces Through Machine Knitting. In *Designing Interactive Systems Conference 2021* (Virtual Event, USA) *(DIS '21)*. Association for Computing Machinery, New York, NY, USA, 1183–1200. https://doi.org/10.1145/3461778.3462007

[9] Pin-Sung Ku, Kunpeng Huang, and Cindy Hsin-Liu Kao. 2022. Patch-O: Deformable Woven Patches for On-Body Actuation. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems* (New Orleans, LA, USA) *(CHI '22)*. Association for Computing Machinery, New York, NY, USA, Article 615, 12 pages. https://doi.org/10.1145/3491102.3517633

[10] Donald A Norman. 2004. *Emotional design: Why we love (or hate) everyday things*. Basic Civitas Books.

[11] Marianna Obrist, Sue Ann Seah, and Sriram Subramanian. 2013. Talking about tactile experiences. In *Proceedings of the SIGCHI conference on human factors in computing systems*. 1659–1668.

[12] Marianna Obrist, Sriram Subramanian, Elia Gatti, Benjamin Long, and Thomas Carter. 2015. Emotions mediated through mid-air haptics. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. 2053–2062.

[13] Keisuke Ono, Shinichiro Iwamura, Akira Ogie, Tetsuaki Baba, and Paul Haimes. 2017. Textile++ low cost textile interface using the principle of resistive touch sensing. In *ACM SIGGRAPH 2017 Studio*. 1–2.

[14] Bruna Petreca, Sharon Baurley, and Nadia Bianchi-Berthouze. 2015. How do designers feel textiles?. In *2015 International Conference on Affective Computing and Intelligent Interaction (ACII)*. IEEE, 982–987.

[15] Delphine Picard, Catherine Dacremont, Dominique Valentin, and Agnes Giboreau. 2003. Perceptual dimensions of tactile textures. *Acta psychologica* 114, 2 (2003), 165–184.

[16] Sara Price, Nadia Bianchi-Berthouze, Carey Jewitt, Nikoleta Yiannoutsou, Katerina Fotopoulou, Svetlana Dajic, Juspreet Virdee, Yixin Zhao, Douglas Atkinson, and Frederik Brudy. 2022. The making of meaning through dyadic haptic affective touch. *ACM Transactions on Computer-Human Interaction* 29, 3 (2022), 1–42.

[17] Edmund T Rolls, John O'Doherty, Morton L Kringelbach, Sue Francis, Richard Bowtell, and Francis McGlone. 2003. Representations of pleasant and painful touch in the human orbitofrontal and cingulate cortices. *Cerebral cortex* 13, 3 (2003), 308–317.

[18] Harsimrat Singh, Markus Bauer, Wojtek Chowanski, Yi Sui, Douglas Atkinson, Sharon Baurley, Martin Fry, Joe Evans, and Nadia Bianchi-Berthouze. 2014. The brain's response to pleasant touch: An EEG investigation of tactile caressing. *Frontiers in human neuroscience* 8 (2014), 893.

[19] Masaaki Yoshida. 1968. Dimensions of tactual impressions (1). *Japanese Psychological Research* 10, 3 (1968), 123–137.