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Foundations of Materials Experience: An Approach for HCI

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ABSTRACT

A growing number of HCI scholars have started to take materiality as an entry point for acquiring a deeper understanding of the possibilities and constraints of design. Steadily moving beyond a distinction between the physical and the digital, a few have also started to look at materials as part of the unfolding of social and cultural practices. Yet, to date, relatively little is known about how these practices develop within the situated experience of materials, and how this situational whole can be supported by design. By contributing to both growing materiality scholarship and emerging practice-oriented approaches in HCI, this paper articulates a framework of *materials experience* that discusses how materials shape ways of doing and ultimately, practice, and how this is rooted in the experience of those materials.

Author Keywords

Materiality; Materials Experience; Practice; Interaction Design; Theory

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

INTRODUCTION

Materials have become more complex: They have started to afford new possibilities of interaction, and be more intimately entangled with social practices [2, 5]. In response, a growing number of HCI scholars [e.g., 18, 50, 64] have started to take materiality as an entry point for acquiring a deeper understanding of the possibilities and constraints of design. This research direction has sparked a large number of contributions, in which materiality is understood and discussed in different ways [e.g., 3, 17, 23, 65].

HCI researchers have started to investigate how to bring material explorations earlier in the design process [13, 57,

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58], and how to effectively incorporate different material substrates [10, 63] and experiential forms [12, 62] into the design of artifacts of blended materiality [20]. This corpus of HCI research is informed by an exploration of emerging materials and technologies, and primarily grounded in interaction design research and practice.

HCI scholars have also started to investigate how to capitalize on the social life of material artifacts [e.g., 1, 36, 45] and the role of material properties [e.g., 11, 30, 42, 49] in the context of a variety of practices, in particular home practices and creative processes of making. This corpus of HCI research is primarily informed by ethnographic work, and increasingly grounded in material studies and studies in material cultures [e.g., 7, 22, 28, 41].

Prominent in these lines of research is a growing interest in the situated aspects of material interactions [e.g., 29, 39, 59], and how these sit in relation to the unfolding and transformation of practice [e.g., 8, 21, 38]. Both these concerns have been highlighted by Kuutti & Bannon [37] as indicative of a growing practice orientation in HCI. Yet, to date, relatively little is known about how social and cultural practices develop within the situated experience of materials, and how this situational whole can be supported by design.

In order to further this understanding, this paper articulates a framework of *materials experience* that brings together the theoretical roots of experience design as already established in the HCI field, and the growing practice orientation of HCI accounts of materiality. The framework describes and examines how materials shape ways of doing and ultimately, practice, and how this is rooted in the experience of those materials.

The proposed framework offers two contributions to HCI. First, it provides a vocabulary for articulating the situational whole in which materials and practices are implicated. Second, it helps illuminate and frame future research at the convergence of materiality scholarship and emerging practice-oriented agendas in HCI [37, 47, 67].

HOW HCI UNDERSTAND MATERIALS

Several accounts are available on how HCI views ‘materiality.’ These range from interpretive accounts of how materiality is theorized in HCI [23] to systematic reviews of material-centered interaction design methods

[65]. Here we tease out and discuss how ‘materials’ have been approached in HCI. With attention to materials, we want to contribute to reversing the emphasis on the physicality of artifacts as opposed to the properties of materials (for important contributions in this direction, see: [3, 11, 49, 57]). Specifically, we want to illuminate how ways of doing and ultimately practice, develop within the situated experience of materials. For this reason, we use ‘materials’ not just to indicate what objects are made of—but the properties, embodiments and arrangements through which they can be experienced and performed [2, 27].

Understanding Materials in Interaction Design Research
HCI researchers have started to investigate how to bring material explorations earlier in the design process [13, 57, 58], and how to effectively incorporate different material substrates [10, 63] and experiential forms [12, 62] into the design of artifacts of blended materiality [20]. This corpus of HCI research is informed by an exploration of emerging materials and technologies, and primarily grounded in interaction design research and practice.

Within this corpus, one orientation is concerned with opening up a compositional sensibility in which digital and physical materials play more equitable roles [e.g., 60, 63]. Contributions to this strand of research have expanded the HCI vocabulary to speak of the ways in which materials come into relation, introducing notions such as ‘texture’ [63]. They have also included steps in the direction of a vocabulary of material properties of computers, with descriptive terms such as ‘computed causality’ and ‘connectability’ [61].

Another orientation is concerned with how to bring material considerations into the design process [e.g., 13, 58]. Contributions have manifested in approaches aimed to explore the dynamic properties of a digital material early on in the process [57]. They have also manifested in articulations of interaction design as form-giving [e.g., 62], studies of material interactions [e.g., 3, 59], and a concern with experiential qualities such as ‘suppleness’ [29] and ‘pliability’ [39] of digital materials.

Finally, we observe a growing ecological orientation in interaction design research. According to this orientation, the way in which we perceive and experience an artifact is not just a property of the straight physicality of materials—it is also implicated in personal and social life [32]. Understanding the link between the qualities intended through the design of material forms and interactions and the qualities that are invoked ‘in use’ within ecologies of material artifacts [e.g., 16, 31] requires a broader understanding of materiality.

Understanding Materials in the Analysis of Practice

HCI researchers have also started to investigate how to capitalize on the social life of material artifacts [e.g., 1, 36, 45] and the role of material properties [e.g., 11, 42, 49] in

the context of a variety of practices, from coordinative practices to home practices and creative processes of making. This corpus of HCI research is primarily informed by ethnographic work, and increasingly grounded in material studies and studies in material cultures [e.g., 7, 22, 28, 41].

Ethnomethodologically informed studies long demonstrated that material artifacts play a crucial role in coordinative practices. There are numerous examples of artifacts whose ‘biography’ and the practices surrounding them have been studied in depth [24, 26, 53]. Additionally, some work has sought to show how in collaborative practices materiality is part of performative action, and how this is supported by the peripheral, evocative and referential function of material properties [4, 30].

More recently, several ethnographic studies have begun to closely examine the material fabric of home practices that develop around cherished possessions. Petrelli et al. [44] have demonstrated how being able to physically arrange, organize and display mementos within the home, enable families to reinforce not just meanings but also the family practices associated with these artifacts, whether mundane [45] or festive [46]. In addition to arrangements, Kirk and Sellen [36] have considered how physicality is fundamental to many of the objects that are cherished, and have investigated the material practices through which things that have been inherited are discarded, safe-guarded or actually used. By emphasizing how objects of sentiment are stored not just to invoke memories but to perform other social functions too, Kirk and Sellen bring attention to the material relationships families have with cherished objects within the home. One example is offered by the material qualities of paper (letter, poster, photo) and how these facilitate a sense of special value. Another example is a jam recipe book, in which both scribbles and jam contribute to the degrading of the book but also to the inscription of social relations. Similar material relationships are described in [1, 42, 43]. In a study of the lives of new university students, Bales & Lindley [1] describe how the subtle, material ways of using a storage basket brought from the parental home inscribe and create an intimate practice linking the student to her home. Odom et al. [42, 43] describe the different material qualities of physical and digital possessions, demonstrating how such qualities impact and engender distinct practices of collection and personal archiving within the home.

Finally, an important strand of research comprises studies of creative processes of making. With studies on knitting, gardening, bookbinding, and hobbyist repair, Rosner et al. [21, 49, 51] have contributed to understand how materials (not just artifacts) are part of the unfolding of skills and practices, and how in turn they are affected by the development of skills and practices. Traces of glue left on the side of the press of the bindery ‘collaborate’ over time to stabilize the properties of the bindery, and to how work

with the press is performed in practice [49]. Similarly, Desjardins & Wakkary [8] have explored the intimate and mutual relationship between goals, materials and competences in the practice of hobbyist jewelers and steampunk enthusiasts.

Summary of Positions

Together, these strands of research express a growing interest in the situated aspects of material interactions, and how these sit in relation to the unfolding and transformation of personal and social life. They are indicative of growing attention in the HCI community to matters of practice: how through the use of things (in the sense of acting upon things) people create meaning in their actions and value for these things [37; see also 56]. Yet, to date, relatively little is known about how materials shape ways of doing and ultimately, practice, and how this is rooted in the experience of those materials.

THE MATERIALS EXPERIENCE FRAMEWORK

Foundations and Rationale

‘Materials experience’ is a phrase that acknowledges the experience people have *with* and *through* materials [35]. Originally, the expression was coined to acknowledge the active role of materials in shaping our internal dialogues with artifacts [33]. *However, we argue, a comprehensive definition of materials experience should acknowledge also the active role of materials in shaping our ways of doing. In other words, it should attend to the aesthetic aspects of experience as much as to its performative character.* The proposed framework offers, therefore, a bridge between the theoretical roots of experience design as already established in the HCI field [e.g., 66], and the growing practice orientation of HCI accounts of materiality.

We ground our account of materials experience in the idea that *neither people nor objects, but instead the mutual interaction between people and objects, gives rise to particular materials experiences.* According to Merleau-Ponty [40], perception has an active dimension and our body is also a permanent condition of experience. Only when *embodied* within an environment, can we turn our attention towards particular objects within that environment and experience the perspectives and meanings that objects evoke. Merleau-Ponty emphasizes that our bodily involvement with things is always provisional and indeterminate.

In accordance with Merleau-Ponty, Dewey [9] stresses that interactions between individuals and their environment are the central point of experiences. Dewey takes experience in its broadest sense and calls it ‘*situation*.’ In his words, a situation is not just a physical setting, but the whole complex of physical, biological, social and cultural conditions that constitute any experience.

Our main assumption, accordingly, is that *the experiential qualities of materials are not fixed.* Materials are experienced in different ways, in different interactions between people and materials, and these qualities can change over time. Drawing on Dewey, we claim that we experience materials on the basis of the characteristics of a *situational whole*. The properties of a material, the artifact in which a material is embodied, one’s previous experiences and expectations, and social and cultural values inevitably affect how we experience and thus act upon things [34]. Taken together, these aspects may construct a different materials experience for different individuals. We name this situational whole as *materials experience pattern*.

As these patterns are made and broken, and become available for repeated interactions, practices may emerge, develop, and disappear. We take a mundane example, a porcelain bowl, to exemplify this. The porcelain bowl, with its unique material properties will lure an individual to interact with it in a certain way. You may handle it gently, caress its smooth surface, or you might expose it to light to see whether it is translucent. These actions by all means are constituted on how aspects of an artifact (e.g., form, process, function), social and cultural aspects of an individual, and setting (e.g., in an antique shop or in a grandmother’s house) interrelate. Embodying a particular material in another artifact (e.g., a conductive ceramic radio, [25]) or placing the same artifact in a different setting (e.g., in a students house) will inevitably affect the way we experience it. After an initial sensorial encounter, we will begin to think that the bowl is delicate, perhaps expensive, and possibly valuable. Simultaneously, the bowl will make us feel in a certain way: its translucency will surprise us, enchant us, and delight us. Over time, we will develop and perform ways of cleaning it in a certain manner, we will end up keeping it in a specific cupboard, and perhaps we will use it on special occasions to entertain social relations. We may even attempt to arrest its decay by removing stains of tea or repair it, in this way influencing how we will use the bowl in the future. The becoming of the porcelain bowl is thus both the medium and the means through which a variety of ongoing practices are performed and realized.

Accounts of materiality in practice theory [52, 55] provide a useful entry point to examine the object capacity to afford an activity in a particular way, and stabilize practice such that they continue to be performed in these ways. They emphasize that affordances cannot be built into an object but have to be explored in practice [54]. They also point out how ‘*inscriptions*’ [6] and ‘*narratives*’ [54] contribute to how material artifacts (e.g., the porcelain bowl of our example) mutually define their meaning and value. However, as highlighted in other studies [e.g., 22, 27, 49], the material of the artifact in practice theory remains strangely unaffected by the practices it enables. It never gets dirty, never ages and never breaks. *We argue, instead, that the link between materials and ongoing performances*

of practice is rather intimate and dynamic—and it is a crucial link.

For this reason, our framework does not adhere to the vocabulary of practice theory as currently established in the social sciences. It uses instead an interpretation of practice as a situated ‘way of doing,’ which unfolds and becomes assimilated into an ongoing set of everyday performances. This understanding extends Suchman’s work [56] by working out the link between initial encounters and ongoing performances *with* and *through* objects from a materialist perspective. The framework also emerges out of the interest to untangle the increasingly complex and dynamic relationship between materials and practices that is developing around digital technologies [31, 68], and that has been observed in foundational HCI studies of the material fabric of everyday practices [36, 49, 51].

Nodes and Relationships

The proposed framework provides designers with a vocabulary to describe a *materials experience pattern*, i.e., the characteristics of the situational whole in which properties of a material, the artifact in which a material is embodied, one’s previous experiences and expectations, and social and cultural values affect our encounters and performances *with* and *through* objects. This vocabulary brings together both interaction design communities and emerging practice-oriented agendas in HCI [37].

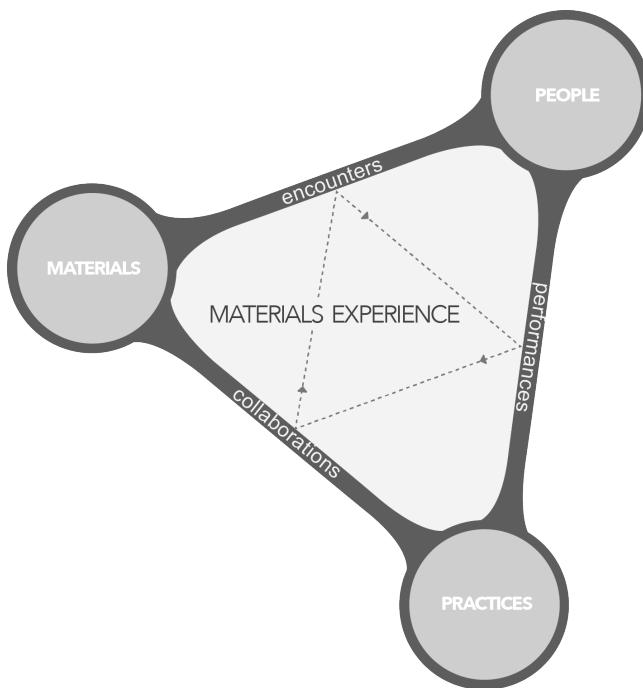


Figure 1: The materials experience framework.

The framework represents a dynamic relationship between *materials*, *people*, and *practices* (Fig. 1). We distinguish ‘*materials*’ as separate nodes from ‘*practices*’ to emphasize the distinction between ‘*materials*’ as part of materiality vs. as physical objects subject to ongoing performances.

Each fundamental node of a situational whole, that is, *materials*, *people* and *practices*, has a number of elements that will influence the ultimate experience of materials.

Materials are characterized by *properties* (such as chemical properties, computational properties, etc.) and the *embodiments* through which properties can be experienced and performed (such as physical form, temporal form, state of matter, etc.). We choose to use the broader term ‘*embodiment*’ to emphasize the richness of forms and states through which materials are encountered and performed. ‘*Embodiment*’ is more coherent with the materialist orientation of this paper, especially in consideration of notions of form in HCI as broader object of design (not necessarily tangible) [e.g., 32, 48]. From this perspective, we make no distinction between physical and digital materials.

People have different *competences* and *values* that come into play, and may as well develop, in a way similar to how properties and embodiments of a material artifact may change in interaction and through performance.

Practices are considered here as situated ‘ways of doing’ that unfold and become assimilated into an ongoing set of everyday performances.

We refer to the relationships between these nodes as *encounters*, *performances* and *collaborations*.

Encounters are the very first interactions with a particular material, when judgments and performances are initially established.

Performances are re-occurring encounters with the ‘same’ material, when judgments and interactions are carried out and altered in the development of practice.

Collaborations are alterations in the material produced by re-occurring performances, which may change the properties of how something is encountered.

Neither material encounters nor performances or collaborations are isolated entities. As in real life, we do things in parallel, simultaneously, and we experience a specific material together with other materials. *Describing the configuration of a materials experience pattern requires a holistic understanding of how materials, people and practices come into relation with each other both ‘in the moment’ (when encounters occur) and ‘over time’ (when performances and collaborations unfold into ongoing practices).*

Experiential Levels

To facilitate this understanding, we suggest that in the situational whole in which encounters, performances, and collaborations come about and transitions from one another occur, materials are experienced at four experiential levels: *sensorial*, *interpretive*, *affective* and *performative*. These levels affect each other in a non-sequential manner.

Sensorial level

Our first encounter with materials occurs at a sensorial level, through touch, vision, smell, sound and taste. Linked to the human sensory system, the sensorial component of experience is omnipresent and inevitable. Materials, with their inherent properties, impact our senses. We like a smooth surface of a metal laptop, and we dislike a sticky rubber handle. Similarly, the digital can shape proximity, visibility of interaction, and ephemerality, and these may ultimately impact on our experience of intimacy.

Interpretive level

The interpretive level concerns how we interpret and judge materials, that is, the situated meanings we ascribe to them after the initial sensorial encounter [34]. Meanings we attribute to materials are usually personality characteristics and associations such as feminine, modern, traditional, toy-like, elegant, etc., and are not factually part of a material's properties or embodiment (i.e., a material is not literally feminine or masculine).

Affective level

Emotions arise often unconsciously, triggered by our inner thoughts, beliefs and attitudes. We can be fascinated or disappointed by the qualities of a material embodied in a specific product. For instance, the easily scratched surface of an electronic devise might disappoint us, and the extreme lightness of a chair might surprise us. Emotions create different affective dispositions towards the embodiment of a material. If something disgusts us, for example, we may be less likely to interact with it.

Performative level

Sensorial perceptions, ascribed meanings and emotions, they all affect us to respond differently to the embodiment of a material. The performances we establish around material objects are significantly influenced by such perceptions, meanings and affects. The unfolding of performances into unique and peculiar ways of doing, and their assimilation into practices, are both mediated and affected by the material character of such performances.

ANALYSIS OF MATERIALS EXPERIENCE PATTERNS

We present and interpret a series of design cases to explore how these concepts may apply.

Methodology

We used the particular perspective being presented in this paper to identify and collect a variety of artifacts manifesting a materials experience pattern geared towards the unfolding of practice (e.g., practices of personal archiving, connectedness, music playing etc.). Sources included various websites of product design companies, commercial magazines, journals and conference proceedings. We collected as many and various products as possible. Then, we applied the four levels of the proposed

framework—*sensorial*, *interpretive*, *affective* and *performative*—in our analysis of these artifacts. Specifically, we focused on how the *performative level* is linked to the other levels.

In this paper, we illustrate two categories of design cases, as an illustrative sample of this analysis. The first group includes designs where materials are capitalized at the sensorial, interpretive and affective level, but not at the level of the practice they aim to support. The second group describes designs where materials play an active role in how the practice unfolds. We argue that how materials are used in this second group fulfills not just a functional or aesthetic role, but plays an active role in the unfolding and transformation of practice. Each group portrays a different use of materials, and its impact on the design of artifacts aimed at supporting specific experiences and practices.

Broken Patterns

In the artifacts described in this section, materials are capitalized at the sensorial, interpretive and affective level but not at the level of the practice they aim to support. We argue that in these cases the links between elements of the materials experience pattern are *broken*.

Qleek

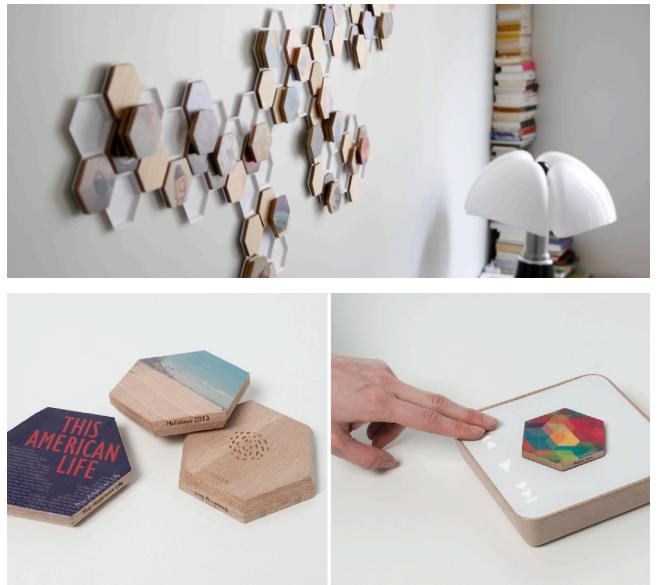


Figure 2: QLEEK by Ozenge (<http://qleek.me/>).

Qleek (Fig. 2) is a digital artifact that aims to bring one's digital life into the physical world. Qleek uses RFID-enabled hexagonal wooden chips to take digital media and memories from the Cloud and materialize them in the users' hands in a rather evocative way. These wooden chips can contain any digital content, from Spotify playlists to Instagram photos to Netflix movies, and can be collected as digital souvenirs or shared as gifts. The user selects the content and the appearance of each chip, and then receives

them at her doorstep. When a chip is placed onto the wood-framed reader, a video may appear on the TV and music may be flowing from the speakers in the room. As the collection of chips widens, digital media become ‘immortalized’ in a wooden honeycomb-shaped collage, and the Hive (the mountable wall plate for chip storage) begins transforming into a colorful tapestry.

Sensorial level: The virtual nature of digital content and the emotions contained in the chips are put into effect by the use of wooden boxes exhibiting a texture that is warm both visually and at touch. The same texture is used to frame the reader.

Interpretive level: Meanings related to the content of the chips are materialized as images and signs printed or engraved on the warm texture of the wooden surface. Their vintage appeal makes them appear as incorporated naturally in the wooden boxes.

Affective level: The revisited vintage appeal of the images and signs on the surface of the wooden boxes promotes a feeling of nostalgia.

Performative level: By collecting and arranging these wooden boxes in a mountable wall plate, a tapestry of digital content can be archived in the form of a honeycomb-shaped collage and made available for casual reading.

In the case of this digital artifact, wood frames the encounter with digital content. But it is not linked to the performances of the proposed practice of personal archiving (i.e., collecting, organizing and reminiscing). The link is realized metaphorically (i.e., making a collage) and supported by a functional form (i.e., hexagonal elements). Whether made of wood or other material, the chips would be able to satisfy the same function as tapestry/collage elements.

Good Night Lamp

The Good Night Lamp (Fig. 3) is a network of interconnected lamps based on global cellular connectivity. It is composed of a Big Lamp and a Little Lamp, anywhere in the world. When a user turns on the Big Lamp by pressing the switch on the chimney, the Little Lamp turns on too. The Good Night Lamp aims to enable users to keep in touch with their friends and loved ones in a rather simple way. By switching on and off the light of the Big Lamp, users can thus share their presence and availability.

Sensorial level: The artifact is in the shape of a home. This shape is associated to the careful selection of a warm material like wood and a translucent polymer surface through which light can radiate.

Interpretive level: The evocative combination within the proposed shape of a warm material like wood, and the translucent surface of the polymer softly glowing in the room creates a welcoming and charming atmosphere.

Affective level: The resemblance of the artifact to a home, and its welcoming and charming character within the room evokes a sense of presence, thus facilitating a feeling of connectedness.

Performative level: By turning on the light inside the home-shaped lamp made of wood and polymer, a user can communicate the act of coming back home, in a way similar to when we turn on the light after entering in a dark room.

Also in this case, wood and polymer frame the encounter with the digital. But they are not linked to the performances of the proposed practice of connectedness (i.e., indicating presence). The link is realized metaphorically (i.e., turning on the light) and supported functionally (i.e., through a switch). Whether made by wood, polymer or another material, the lamp could still be switched on and off.



Figure 3: GOOD NIGHT LAMP by Alexandra Deschamps-Sonsino (<http://goodnightlamp.com/>).

Active Patterns

In the artifacts described in this section, materials play an active role in how the practice unfolds. We argue that how materials are used in these artifacts fulfills not just a functional or aesthetic role, but plays an active role in the unfolding and transformation of practice.

Seaboard Grand

Seaboard Grand (Fig. 4) is a musical instrument that reimagines the piano keyboard as a soft, continuous surface. The Seaboard’s polyphonic pitch bend, vibrato and per-note dynamic changes are all available at the fingertips level, combining the intuitiveness of a traditional instrument with the versatility of digital technology. Continuous touch enables the user to sound a note and then take it on a musical journey, modulating its pitch, volume and timbre through one continuous gesture. The unique form of passive tactile feedback offered by the instrument makes it easy to sense the slightest change in pressure, thus offering a far more organic experience than traditional aftertouch.

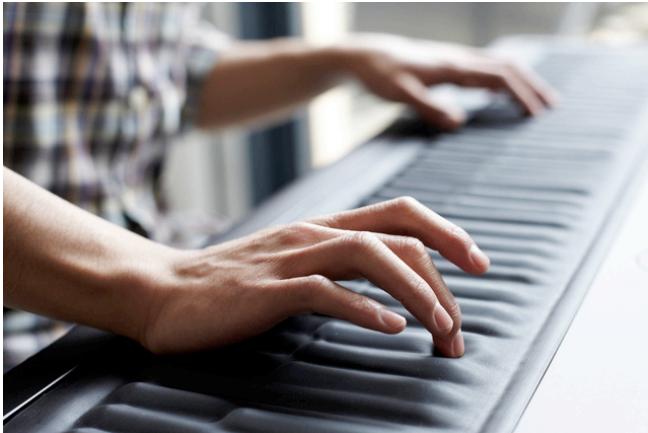


Figure 4: SEABOARD GRAND by ROLI
(<https://www.roli.com/seaboard/>).

Sensorial level: Compared to a traditional keyboard, the artifact feels soft to touch, it is elastic, slightly resists to pressure, and makes no sound (not the instrument, but the material). The unique ripple surface of the silicon also looks soft.

Interpretive level: In a highly intertwined sensorial manner, the softness and ductility of the product, and the way its material enables new ways of playing an instrument, may bring us to think that the artifact is high-tech and cutting-edge.

Affective level: Perceptions of softness and ductility, and the meanings attributed to the artifact as cutting-edge, captivate the user and foster fascination.

Performative level: By moving and rubbing the hand over the board, the user can gain tactile control of the magic sound and explore new ways of playing music.

How the silicon is formed, its resemblance to a standard keyboard invites us to experience this familiar yet different musical instrument. The difference obviously comes with the material choice. Playing a Seaboard becomes a materials experience in which sensorial, interpretive and affective qualities of the interaction are intimately linked to ongoing performances of playing music.

Soft Lamp

Soft Light (Fig. 5) is not a digital artifact. However, we have included it in the paper due to its unique pattern. It is a lamp that can be used for illumination, but it is unique and conspicuous for its soft nature. The artifact is made of an elastomeric material. The use of this material involves unconventional practices of squeezing and pressing not usually associated to lighting items. The light bulb inside is protected from breaking by a cage. The power comes through a red cord connected to the lamp's narrow part. This soft, pumpkin-shaped product produces soft light, but because of its ductility can also be used as a warm and

pleasant pillow, or as a crevice-filling device to be placed between any object and a wall, or between two objects, without fearing that it will get broken or damaged.

Sensorial level: The use of the foam makes the artifact soft, ductile and capable to emit a physically warm glow.

Interpretive level: Combined with its mobility, properties and form of the artifact allow changing its meaning and appearance from a lifeless item to an active, playful, everyday life component.

Affective level: The versatility of the artifact enables the lamp to serve multiple purposes, and stimulates amusement and improvisation.

Performative level: By using the lamp in a playful and open-ended way, the user can explore a variety of ways in which to use the artifact. This exploration is tightly link to the material used (i.e., a soft and ductile foam, capable of emitting a physically warm glow).

In this case, because many are the ways in which the lamp can be used, we argue that the artifact is deliberately designed to be multi-purpose. Here the elastomeric material plays an active role in how practices unfold (e.g., filling a crevice, holding the weight of another object, staying warm at home).



Figure 5: SOFT LIGHT by Simon Frambach
(<http://www.simon-frambach.com/>).

DISCUSSION

We hope to have illustrated how the proposed framework can be used for analyzing a *materials experience pattern*. By contrasting different materials experience patterns, we also wanted to draw attention to the link between the aesthetics of a design (i.e., *sensorial, interpretive, affective level*) and the performances that are carried out with and through its materiality (i.e., *performative level*). We wanted to point out that when the link to the performative level is *broken*, the design usually relies on familiar metaphors (e.g., making a collage, turning on the light) in order to promote a certain practice. Because in these cases performances are not peculiar to the unique properties of the material, the design usually expresses an aesthetics in which socio-cultural meanings are highly crafted and codified (i.e., the vintage look, the shape of a home). This is not wrong. But in HCI, we argue, this may lead to a ‘gift-

wrapping' approach [15] whereby designs are concerned with the digital augmentation of socially and culturally established practices. On the contrary, when the link to the performative level is *active*—i.e., when performances are rooted in the unique properties of the material —people may explore and develop unanticipated practices.

We know that people experience materials in different physical and temporal forms [62] and states of matter [10]. However, as argued in [31], the way in which we perceive and experience an artifact is not just a property of the straight physicality of materials, that is, a matter of form and interaction (as intended at design time)—it is also implicated in personal and social life.

We are not suggesting that a straight study of materiality would not consider the experience of that materiality. But the transformational character of using the framework is in taking materials as an entry point to shape ways of doing and ultimately, practice, and rooting this in the experience of those materials. The benefit of a materials experience approach, we argue, is more than moving beyond the distinction between the physical and the digital. *Rather than using the digital as an add-on to recognizable practices, configuring material experience patterns facilitates the use of computational properties as a material for unfolding and transforming social and cultural practices.* More can be done with digital artifacts, once we shed light on how practice develops within the situated experience of materials [19]. As pointed out in [14], the situated, performative engagement with materials that are not necessarily familiar has been a largely unexplored topic in the HCI research field.

Reversing the emphasis from researching people and their individual relationships with material artifacts to materials experience is a paradigmatic shift for designers. It means working with the properties and experiential qualities of materials as conditions for ongoing encounters and performances and ultimately, the development of practice. Understanding materials experience patterns will pave the road to new ways of designing. *It will enable designers to envision and create a situation in which a desired practice is likely to unfold: even more importantly, a situation in which people are equipped and empowered to assimilate the design into their ongoing performances.*

This paper makes a first step in this direction by providing a vocabulary that brings together both interaction design communities and emerging practice-oriented agendas in HCI [37]. How to envision and configure a materials experience pattern is the next challenge. It will require material thoughts that occur synchronously with design ideation, and which permit the material to 'lead the way' in the potential unfolding of social and cultural practice.

This challenge will entail new interdisciplinary alliances and design processes. It will also urge HCI scholars and practitioners to broaden their investigations to how data and

algorithms might modify the experience of materials, and move beyond preoccupations with how to digitally 'augment' socially and culturally established practices. As new materials begin to have the ability to manifest the passing of time, accumulate experience from past performances, negotiate interactions and align interests, *configuring materials experience patterns will become increasingly important to the rooting and transformation of a variety of practices.*

CONCLUSIONS

This paper articulates a framework for *materials experience* that discusses how materials shape ways of doing and ultimately, practice, and how this is rooted in the experience of those materials.

The paper starts with describing the motivation for this research in the context of current HCI concerns for materiality. In doing so, it provides a thorough review of existing work on the basis of how different strands of HCI research consider and frame the role of 'materials.' The paper then continues with the description of a framework of *materials experience*. This is described as constituted of several nodes (*materials, people, practices*), relationships (*encounters, performances, collaborations*), and experiential levels (*sensorial, interpretive, affective, performative*) By means of design cases, the paper shows how the proposed framework can be used for analyzing a *materials experience pattern*. By contrasting different materials experience patterns, the paper draws attention to the link between the aesthetics of a design and the performances that are carried out *with* and *through* its materiality. The paper concludes by discussing transformational character and benefits of the framework, and emphasizing that when performances are not peculiar to the unique properties of the material, the design usually expresses an aesthetics in which socio-cultural meanings are highly crafted and codified. On the contrary, when performances are rooted in the unique properties of the material, people may explore and develop unanticipated practices.

As HCI community, we lack an in-depth study of the experiential aspects when we are to speak about materiality and practice in the context of HCI. The proposed framework offers two contributions to HCI. First, it provides a vocabulary for articulating and configuring the situational, experiential whole in which materials and practices are implicated. Second, it helps illuminate and frame future research at the convergence of materiality scholarship and emerging practice-oriented agendas in HCI, by connecting important understandings produced within these strands of research to the theoretical roots of experience design as already established in the HCI field.

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