# PRECIOUS MATERIALS OF INTERACTION – EXPLORING INTERACTIVE ACCESSORIES AS JEWELLERY ITEMS

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## ABSTRACT

In this paper we present a series of design explorations on the theme of wearable and mobile technology through the lens of jewellery design. This is done by looking at properties of traditional fine jewellery in terms of material considerations and crafting processes, as well as considerations related to patterns of wear and interaction. By using jewellery as a point of departure, both theoretically and practically, we discuss four topics: a) the gestalt of electronic artefacts versus jewellery design, b) material preciousness, c) interactive properties of physical materials, and d) jewellery usage as an inspiration for new interactive designs.

## INTRODUCTION

Mobile personal interactive devices have much in common with traditional fine jewellery. They are typically put to display on or close to the body, and can trigger strong feelings of personal attachment. How they are chosen, worn, and used will shift over time with fashions and trends, and depend heavily on local and social contexts. They can be expensive, as they are both constructed using sophisticated tools and advanced skills, and many will consider them unnecessary – as luxury objects that could be lived without. Yet, they are also very different. Apart from the most obvious – traditional fine jewellery is very rarely interactive – most commercially available electronic products reflect a specific aesthetic gestalt that stands in sharp contrast to that of fine metal craftsmanship. Their outer shells are normally based on plastic or composite materials and bring to mind ideals of what could be described as a form of 'industrial-, sports- and spaceship aesthetics'. And while fine jewellery is commonly designed to last, electronic products are not.

Jewellery can be defined as adornments attached to the body or clothes, such as necklaces, earrings, bracelets and rings. Precious metals and gemstones have been the predominant materials used for crafting such items, but other materials as wood, shells and plant seeds were also used. Crafted and worn from the beginning of human history, they bear aesthetic functionality as items of adornment, parallel to functioning as strong signifiers of local social hierarchies and customs, but also reflecting cultural values. What makes jewellery interesting to explore and analyze in a product and interaction design context, is the fact that they involve several aspects that have recently gained interest in the fields of interactive technology, such as aspects related to aesthetics, materiality, crafting/making and cultural expressions. Additionally, looking at the way wearable and mobile electronic products are designed and adopted through the lens of jewellery may open up to new directions for thinking about concepts such as sustainability or obsolescence, which is highly relevant to the fields of product and interaction design.

The research presented in this paper has been conducted by bringing together knowledge from different fields and by combining interactive technology design with crafting practices of contemporary jewellery. Apart from explorative design work in collaboration with a

Figure 1: Recent product images on the theme of interactive accessories (clockwise): a) Pebble, b) Flic button, c) Ringly and d) Sony Smartwatch (all images from respective company's own online product description).

professional jewellery designer, the project has also hosted three collaborative workshops with students and fellow researchers in interaction design. In this paper we first present a series of example artefacts resulting from these activities and thereafter discuss topics that emerged by critically explore the relationship between fine jewellery and wearable technology.

## BACKGROUND

This work is placed at the intersection of mobile interaction design, interactive art and fashion studies, with a specific focus on what we here call *interactive accessories*, including aspects of use as well as materials and crafting practices. This area stretches over a broad range of topics, including the conceptualization of mobile devices as a form of fashion accessories, but also design trends in function features, patterns of using technology and potential street fashions among mobile electronic products (see Figure 1). Previous work discusses mobile devices being treated as fashion accessories, reflecting visual aesthetics in public, being part of an ensemble, or used as temporal variation of style (Juhlin & Zhang 2011). Moreover, a range of fashion concepts has been

discussed in human-computer interaction and interaction design, from a perspective of how fashion can influence sustainable practices in adopting technologies (Pan et al. 2012; Pan & Blevis 2014).

Apart from mobile devices being part of existing dressing practices and fashion, the field of wearable technology is specialized in novel interactive technologies embedded into clothes, accessories or jewellery. Defined by Seymour (2008) as *" 'designed' garments, accessories, or jewellery that combine aesthetics and style with functional technology"* wearable technology or fashionable wearables has been an established research area at least for a decade now. During that time a vast number of prototypes and products has been developed, bridging knowledge from the fields of fashion, engineering and interaction design. These range from accessories for measuring and tracking body data, mostly for sports (see e.g. http://www.fitbit.com) or health (Ståhl et al. 2011) contexts, but also conceptual designs experimenting with sound or light as decorative, performative and artistic expressions (e.g. Elblaus et al. 2015). Additionally, on a research level, design scenarios have been developed for how electronics and sensors



Figure 2: a) Workshop with a jewellery designer Emma Rapp and interaction designers, b) and c) crafting jewellery forms with copper and electronics.

could not only be part of clothes, but also directly on our body, such as the *Skin: Tattoo* project by Philips Design[1], and interaction through RFID-tags embedded in fake nails (Fuks et al. 2014).

A subsection of the wearable technology field has during the past decade been exploring how jewellery could be combined with electronics to acquire additional functionality. Sarah Kettley through her *friendship jewellery* studied the social activity of greeting among members of friendship groups (Kettley 2005). For Kettley, such types of interactive jewellery was used as a way to raise attention to someone's own body, but also to make the wearer aware of cultural and social assumptions related to technologies we use (Cranny-Francis 2008). Additionally, Jane Wallace has done extensive work on the topic of digital jewellery, mostly towards exploring personal attachment to such objects and human relationships (see e.g. Wallace et al. 2005; Wallace et al. 2007).

Since these explorations, significant technological developments have radically changed the possibilities of actually realizing more sophisticated interactive accessories. With the recent advancements in low energy wireless connections (e.g. Bluetooth Low Energy, ANT+) the size of prototyping circuit boards can decrease to a great extent, compared to e.g. Arduino Lilypad (Buechley et al. 2008), which previously has been used in most wearable technology projects. This development has opened up a design space for new interactive scenarios, where wearable designs and interactive accessories can be made to communicate wirelessly with each other and with a range of consumer devices, such as smartphones. Along that strand there is currently a re-growing interest on designing fashionable wearables 'that look really good as well as function really well, rather than things that look like cellphones taped to the wrist', as described by Intel's device boss Mike Bell on an interview at the online website Pocket-lint[2]. Similarly, companies such as Cuff (www.cuff.io) and Ringly (www.ringly.com) have started to design interactive jewellery objects that look more like well-chosen accessories based on contemporary fashion trends.

Another related discussion is the resurgence of craft in fashion (e.g. Busch 2010) and interaction design disciplines (e.g. Bardzell et al. 2012; Buechley & Perner-Wilson 2012; Tsaknaki et al. 2014) blending new types of materials, processes and tools with electronics and 'traditional' knowledge and expertise. As mentioned by Gross *et al.* (2013) *'the craft view helps explore the communicational dimension of material interactions, foregrounding ways that all aspects of interaction—* *including design, everyday use, and even research—are rooted in tradition.'*

## DESIGN EXPLORATIONS

The project reported on here is an interdisciplinary collaboration between the research team, who all have background in product and interaction design, with the jewellery designer Emma Rapp, who is based in Stockholm. Apart from one full year of explorative design work in collaboration with a professional jewellery designer, the project has hosted three collaborative workshops with invited guests. The first workshop had a conceptual focus and was conducted with fellow researchers and research students in interaction design. The second workshop focused more specifically on traditional materials with interaction designers and researchers in a conference setting. A third workshop was held with practicing jewellery designers and focused on the possibilities using new technology. Each workshop was one full day, and resulted in further design explorations and conceptual development in the research group.

Among the many prototypes, sketches and explorations produced through these activities, we have selected four examples here to present as concrete examples and also to ground a discussion. The examples are:

- Seaweed speaker made of leather, silver and copper,
- A copper and silver button,
- Nebula, a garment for generating soundscapes,
- A wooden hair needle with interactive light

Below is a brief description of the four examples, followed by a general discussion.

### SEAWEED SPEAKER

The first design presented here is a portable and wearable speaker, crafted out of copper, silver and leather. This design was guided by Japanese ideals of wabi-sabi, that nothing lasts, nothing is finished and nothing is perfect (Powell, 2004). This resulted in a design that was organic in shape and made from a mesh of organic and recycled materials. The electronics of a typical mobile speaker were reused and integrated in a physical design that resembles a sculptural seaweed plant. The sound comes out of a seashell, made out of copper in a spiral form. The speaker is embedded inside this copper shell and the cables connecting the speaker to the circuit board are sewn in the main structure of the necklace, which is made out of leather, as seen in Figure 3a. Additionally, the circuit board is hosted inside a silver box made in the shape of a mussel shell and coated in enamel. It functions as a box that can open and close, which makes it possible to remove the circuit board in case parts of it need to be repaired. Another detail is the plug of the speaker attached to a phone or a laptop, which is hosted inside a small silver shape. The basic function of the device remains the same, which is to listen to the music or sound from a mobile phone or a laptop, whereas the form factors, such as shape, texture, materials but also the way the speaker

Figure 3: a) Exhibiting the seaweed speaker, while connected to a laptop, b) wearing the seaweed speaker as a necklace, c) listening to the music from the copper shell-speaker.

can be used, have changed. In order to listen to the music from the seaweed speaker, someone can either place it on a surface as shown in Figure 3a, or wear it as a necklace (Figure 3b). If worn as a mobile accessory, the person who wears it can bring the copper seashell, where the speaker is hosted, close to the ear to listen to the music or sound (Figure 3c).

COPPER AND SILVER BUTTON

The second design presented here was developed by two workshop participants with an engineering background, who explored how buttons or zippers embedded in clothes could be designed as input sensors. Since many clothes already have such types of visible details, they saw an interesting design space when it comes to designing for example buttons embedded with technology. The envisioned use case of this button is identical to recent products such as the Flic button (see www.flic.io). Depending on the design and setup of the software, the pressing of the button can be mapped to a large number of possible actions in a computer or a phone, such as answering a call, taking a picture or posting something online. Inspired by jewellery crafting, such buttons enhanced with electronics could consist both a decorative and a functional part of an outfit. The specific button is made out of copper and silver, cut in two separate, round plates. In between the two metallic plates, a small Bluetooth Low Energy circuit board is placed, which connects to the two plates with small cables and also to a mobile phone wirelessly. In between the metallic plates a thin layer of wood is placed as insulation. When both of the metallic surfaces are touched, as seen in Figure 4a, the

circuit is 'closed' due to the skin resistance and the conductive properties of such metals. The same can happen if one side of the button is already placed next to the skin and the person touches only the other side.

THE NEBULA SOUNDSCAPE GARMENT

Our third example (Figure 5) was crafted as a material exploration together with research students specializing in interactive sonification and interaction design. The metallic properties of the design materials were in this case taken to an extreme, with a large number of metallic studs, each connected with conductive copper thread, and set up to react to the movements of the wearer and responding with an ethereal soundscape (see also Elblaus et al. 2015). The design process of this object included not only the aspects of the soundscape and interactions in the form of physical movements, but importantly also many hours of physical crafting practice to actually manufacture the garment.

Two versions of the garment were created to test different ways to practically realize the vision. Copper thread was used to connect each of the studs, which were ordered in different clusters. When an active stud touches a stud in a receptive cluster, an electrical connection is made, alerting the electronics that the garment is moving. The very conductance of the studs was thereby used as an interactive feature rather than just as a decorative detail of the garment itself.

WOODEN BLING HAIR NEEDLE

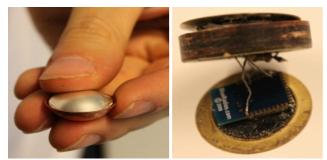As part of exploring how electronic accessories can be



Figure 4: a) Prototype button crafted out of copper and silver, b) The electronics hosted inside a previous version of the 'copper and silver button'. Conductive thread used to connect the metal surfaces with the BLE module.
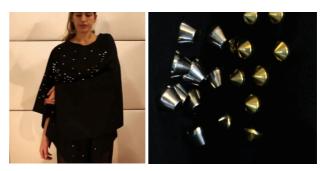


Figure 5: a) Overview image of the Nebula garment,, b) Closeup of the studs on the front side of the garment, which upon touching will wirelessly control a soundscape played on a mobile device.

Figure 6: Prototype of the wooden bling hair needle made of wood, hand painted silk fabric, conductive thread, LEDs and an accelerometer.

designed based on jewellery aesthetics and properties, we made a hair accessory with embedded lights (Figure 6). The motivation for the specific electronic jewellery was to explore LEDs, which are considered one of the most basic electronic components, as a material for jewellery crafting. For this reason we chose to work with a simple set of Aniomagic Chicklet LEDs combined with an additional accelerometer component (see www.aniomagic.com). Since movements of the head correspond to basic movements of the body, for example if a person walks or stays still, we explored different patterns of blinking lights that change according to such movements, as detected by the accelerometer. The design of the accessory was inspired by the shape of jellyfishes, but was to a large extent affected by material considerations, both related to jewellery-crafting materials, but also with respect to the properties of the technology. Firstly we tried possible ways of combining LEDs with silver and wood, such as carving the wood for hosting the small LED boards, or using the conductive properties of silver and conductive ink for connecting them to the battery. After we chose wood as the material for the main structure, we crafted a three-dimensional shape, where the LEDs would be kept in place with conductive thread stitched through small holes opened in the wood pieces (Figure 6a). In order to create a subtle and expressive diffusing LED light effect, experiments were made with different types of hand-painted silk fabric, wrapped around the three-dimensional wood shape. After switching the hair needle on, it can be worn as an accessory for keeping the hair in place (Figure 6b), while the diffused light patterns, visible through the silk fabric, change speed and intensity according to the degree of movements performed by the wearer.

## INTERACTIVE ACCESSORIES FROM A JEWELLERY PERSPECTIVE

Having the design explorations above as our starting point, we elaborate on four topics that emerged throughout this research process. Our aim is to discuss what can be learnt from jewellery practices in order to address the expanding cultural contexts in which technology is used, and for whom it is designed. The topics that will be discussed are a) the gestalt of electronic artefacts versus jewellery design, b) material preciousness, c) the interactive properties of physical materials, and d) jewellery usage as an inspiration for new interactive designs.

## GADGET AESTHETICS VERSUS JEWELLERY DESIGN

Why are some interactive accessories perceived as gadgets and others as pieces of jewellery or other things? The identity or 'gestalt' of a designed artefact is determined by a number of factors related both to the aesthetics and to the perceived functionality. Taking into account the formgiving identity of an electronic product, jewellery practice can contribute with means of re-dressing technology, in order to produce alternative identities or gestalts that open up the design space of what a piece of interactive accessory or wearable electronics could be. Two means for elaborating with the formgiving identity are discussed here; *craftedness* and *materials*.

By taking on an artistic perspective of fine jewellery, the designs explored here were pushed radically into contexts of artistic expression, material exploration and crafting, rather than more efficiency-related aspects that would probably be put to the fore in more industrially oriented design cases. As interaction designers, we also saw the opportunity to focus more on the physical aspects of the designs than we would normally allow ourselves, bringing issues of surface level appearance to the fore. Also, none of the designs should be looked upon as a finished suggestion for a real product, but rather as research explorations that focused on the material aspects in order to gain new understandings for future design scenarios (Fernaeus and Sundström, 2012).

The materials that are currently dominating the user experiences of electronic products are often based on plastics and aluminum compounds, bringing to mind athletic gear, or sleek and polished aesthetics. These norms became questioned and challenged in each of the design explorations above. From our explorations it became obvious that the unique crafting properties and the types of materials used in jewellery can inspire new directions for the design of electronic and interactive accessories on a very fundamental level.

A main difference between fine jewellery and most existing interactive accessories is the way they are crafted, which affects their aesthetic gestalt but also how they are treated. What characterizes jewellery, in the contexts explored here, is that it is handmade using slow and time consuming crafting processes, a fact that potentially gives 'unique' qualities to such items. Mass produced electronic products are normally much more homogeneous as designs, even though there is a growing interest in designing more varied electronic accessories. With increasing popularity in maker practices around electronic products, and also significant improvements in terms of easy-to-use tools, the arena for handmade and uniquely produced interactive accessories will potentially grow significantly in the upcoming years.

In the design explorations presented above, the choice of materials and crafting practices took on a very fundamental role compared to the typical design case of interactive and wearable electronics. The lack of features that typically identifies a gadget such as clearly distinguishable input and output components like LCD-screens and buttons make the devices less easily classified as 'gadgets'. For example, the seaweed speaker crafted out of copper and leather can be worn as a necklace for enchantment, apart from being only as device for listening to music. Additionally, the handmade silver and copper button being both a button attached to clothes and an interactive control for different applications, may be valued both as a unique button and as an input/output device. Therefore, combining properties of jewellery practice, in terms of crafting and material considerations, with properties of interaction may increase their perceived value and lead to longer adoption of such products. The choice of materials and techniques points to a different aesthetic direction compared to the buttons used in activity bands and similar devices. Here it is not so much about hiding the functionality as it is about re-dressing it and giving it another identity.

MATERIAL PRECIOUSNESS

As described by Djajadiningrat *et al.* (2004) an electronic product as a physical *thing* has both a formgiving identity (or gestaltung) consisting of form, colour, texture and materials, but also an additional 'inner layer' consisting of the electronics, such as cables, circuit boards and sensors, which are responsible for the functional or interactive properties of the product. In many design cases, the formgiving identity of an electronic product is added on top of the electronics (cables, circuit boards, sensors etc), which results in bulky designs that reflect a 'function over form' aesthetics. But especially when it comes to the material form of interactive accessories, additional aspects of culture and style need to be considered, so that such products could both function well and be appealing to people on a fundamental material level. This may be especially evident in the case with expensive and fine jewellery made of materials such as gold and pearls, but it relates also to less expensive accessories, made of copper, silver, wood, leather and other materials that to some extent are perceived as 'authentic' or 'natural' compared to plastic or composites. All examples presented above could thereby be read as a reaction to the current design norms within the domain of electronic accessories, on a fundamental material level.

It should be noted however, that designing interactive artefacts with a focus on craftedness and materials is also problematic. Expensive jewellery and watches are often used as signifiers of social class. Even though electronic artefacts also can have this function, the fact that they are commonly mass fabricated using cheap plastic materials in its outer casings, and the fierce competition and technological advancements have led to cheaper products that more people could afford and in a sense a democratization of technology. The ongoing trend in wearable electronics towards fashionable and exclusive devices could potentially endanger this positive aspect of existing gadget aesthetics.

At the same time, dismissing the value of jewellery materials as only a marker of class, as in expensive artefacts, would be a simplified interpretation of how jewellery is valued. Jewellery can take on many different aesthetic forms and is worn as identity markers across a wide spectrum of socio-economic groups, subcultures, religions and contexts. In that respect the pluralism in terms of design ideals available in jewellery practice is more varied and inclusive than what has been present in the design of electronic artefacts. Note that none of the examples presented in this paper adheres to a cliché image of jewellery as expensive items for 'princesses', but rather attempt to explore the boundaries of what an electronic accessory, inspired by the aesthetic richness of jewellery, could be like.

Also on a material level, the examples presented here address the preciousness of the materials as a value beyond only their respective monetary cost. In the traditions of using precious metals for jewellery, the materials themselves are considered valuable in a way that is rarely discussed in electronic product design. Gold and silver has throughout history been melted down and molded into new shapes, and gemstones can be reused infinitely into new arrangements. Although there is some societal pressure to recycle and reuse electronic parts, in the context of broken appliances the consumer culture keeps devaluing parts of non-functioning, no longer attractive devices, as of little value. Bringing more focus to the traditional philosophies of jewellery to the design of electronic products could result in designs where parts will be considered more valuable in themselves, and where unused parts would not be discarded but made useful in new arrangements. This can be seen for instance in the seaweed speaker above, where an existing device has been modded into a new shape together with different materials. Inspiration from the material values of jewellery could in this respect be interpreted as a *bricolage practice* (Vallgårda and Fernaeus, 2015), which makes use of available resources and skills to more fundamentally guide the design process, compared to gadgets that are formed more from a perspective of mass-manufacturing processes.

INTERACTIVE PROPERTIES OF PHYSICAL MATERIALS

The examples presented above illustrate how the conductive properties of metals such as silver or copper, as well as the non-conductive properties of materials such as leather and wood could be further explored in interaction design. Specifically, the examples pointed to some directions on how to use such materials for designing not only the visible interface of electronic accessories, but also part of the physical structure and interactive behaviour of the design. This could be seen as a follow up on works such as Perner-Wilson and colleagues' explorations with hand crafted textile sensors (Perner-Wilsson et al, 2010). The field of interactive accessories and wearable electronics could in this setting

be regarded forming a complex hybrid space in between interaction design, electronics, and practices of making clothes, accessories and jewellery.

As a new language of form may stem from the introduction of more varied physical materials into interaction design practices (Binder, T. Redstrom 2006), new types of engagement and relationships might develop between a user and a device. Designing electronic products with materials such as copper, wood, silver or leather can result in radically different ways to interact and engage with products, for example to browse on a screen, push a button, or control other functions. There is a different feeling in touching a copper button, or a leather cable, also because these materials carry specific cultural meanings and values, which emerge by using a product made out of such materials. According to Verbeek and Kockelkoren (1998) *'some materials, such as leather, may also become more beautiful when used for some time, whereas a shiny, polished chromium surface starts to look worn out with the first scratch' (p. 30)*. Materials such as copper, silver or leather, develop a patina on their surface over time. This property could be used for creating patterns of interaction and usage, or as a visual element to reflect upon usage, signifying for example areas or buttons that have been 'pushed', or 'touched' more than others. A leather button or a copper surface as an interactive control will gradually change both colour and texture over time and will therefore signify aspects of aging and usage, with memories and personal stories inscribed on it. Potentially, this could also result in electronic products that would look and feel more authentic, and be treated less as artificial add-ons to existing cultural contexts.

Using the natural conductance of metals as a design material would be one way of bridging the gap between formgiving and electronics. In the example of the 'copper and silver button' again, the external handcrafted metal surfaces are part of the way the wearer interacts with the electronic module. Moreover, since metallic compounds are already used for the external casings of mobile devices or similar products, these could be further explored as a material that would also play a more direct role in the actual interaction, instead of functioning only as decorative casings. Within that context, we should consider how the domains of fashion and technology could collaborate on a material level to resolve the problem of adding technology on top of already designed devices, responding to the desire for a more varied range of aesthetic expressions.

THE USE PRACTICES OF WEARING JEWELLERY

Mobile and wearable devices that are designed as consumer products are as such often based on the logics of planned obsolescence where artefacts are expected to be used and function only for a limited period. Expecting longer term usage of electronic gadgets may also seem to be opposed to changing fashion trends and also the fast pace in which new technological inventions appear and replace one another. This circumstance has during the last decades been brutally evident in products such as mobile phones, digital cameras, and different forms of portable music players. In contrast to the ways electronic products are being worn and treated as short-lived gadgets, certain types of jewellery have been crafted not only to last longer as physical objects, but also to be worn far beyond temporal fashions. Some items, e.g. wedding rings, may be worn on a daily basis by a person for decades, while other items are decorative adornments used only for rare special occasions or selected among a collection of accessories to fit with a specific outfit.

These are interesting aspects of jewellery that were not explicitly addressed in our design explorations, but that we found central in order to come up with realistic use cases and scenarios. There are important differences between expecting a device to be used constantly or only for special occasions. This relates to a number of discussions around longevity that have been raised lately, mostly from a perspective of sustainable practices when it comes to adopting technology (e.g.Blevis 2007; Blevis et al. 2007). Blevis (2007) studied how 'promoting quality and equality' of an electronic product could be a way to encourage longevity. He described that both the quality of a product and the possibility of providing equality of experience to new owners whenever ownership transfers, are important properties for expanding the time an electronic product can be used. Similar to Blevis' position is Nelson and Stolterman's (2003) notion of *ensoulment*, being both a design principle and a mechanism to promote sustainable interaction design by increasing the psychological attachment to electronic products. The idea of ensoulment is described as '*a feeling of deeply moved and as a consequence, a feeling of being significantly changed*, by a *meaning and value of a design'* (Blevis & Stolterman 2007) and implies deeper engagement with a product as a way to create longevity.

Significance and meaning inscribed in materials and crafting processes could in certain cases create longevity, but with longevity comes significance and meaning. For example jewellery worn throughout a person's life acquire value over time and become objects of attachment that carry memories and personal histories, sometimes inherited by the next generation, as heirlooms. Similar values can also be attributed to old watches and other artifacts that could last long and be repaired when broken. This value that jewellery or old watches can have, has been thought to result in a longer lifespan of these items. Wallace *et al.* (2005) have studied the longevity in relation to electronic jewellery from a perspective of personal attachment and memories. For them, seeing a product enhanced with technology as *gadget* might result in a shorter-term engagement.

Despite the logics of this discussion, we find it difficult to see that electronic products designed from a jewellery perspective by itself would result in them being worn and used for longer. An important aspect of industrial design efforts towards a mass market is more rigorous testing, which should result in more robust solutions than handcrafted electronic artefacts would ever be able to

promise. The wooden bling hair needle for example, invites for a careful handling as a piece of jewellery rather than a gadget with embedded LEDs. The fragile properties of the piece, being meticulously crafted out of wood and electronic components blurs the boundaries between fine jewellery and an electronic product, yet it does not make any convincing promises of longevity. Accordingly, this design space could certainly benefit from a stronger focus on robustness, inspired by the temporal qualities of traditional jewellery use practice.

Studying interactive accessories from a perspective that covers aspects of crafting, materials, interaction and culture, we need to consider the body as a central physical and social entity. The way people use mobile devices or wear technology in public constitutes part of a broad fashion practice, including aspects of design, but also dressing practices and performance of identities. Taking into account the view that fashion should be seen as an embodied practice rather than a mere consumption phenomenon (Entwistle 2000) we need to consider how mobile and wearable electronics are important agents of such practices.

This is an interesting domain for bridging design and technology, since it concerns publicly visible items that are worn close to the body, associated with (sub) culture, dressing practices and digital functionality. For example, Juhlin *et al.* (2013) presented an exploratory design experiment on how mobile technology could be designed with more direct inspiration from local dressing styles, instead of being designed as electronic products among others. According to Pan and Blevis (2014) we need to study how fashion as a social phenomenon affects the changing cultures, lifestyles but also people's consumption behaviours, especially with respect to interaction design materiality. Jewellery as strong signifiers of personal meaning and culture may then provide important insights for designing aesthetic experiences with interactive accessories as continuous everyday experiences, emerging from the interaction between wearer and object (Wright et al. 2008). Value depends on a number of aspects that cover material properties, uniqueness, craftsmanship etc. and also symbolic values related to, for example, the history of the piece, personal meaning and attachment.

Specifically, interaction with technology must be considered as part of specific social contexts, taking into account what people actually wear and the ways identity is being performed, but also how the choice of products could be a way e.g. to make fashion statements and to communicate group belongings. As described by Schechner (2002) the rich repertory of people's actions and behaviours, but also the social, gender, and class roles that are regularly enacted and re-enacted in everyday life contexts, are considered as a form of everyday life performance. Clothes, jewellery and accessories that people choose are items that strongly support these types of performances. People choose clothes and low-tech accessories to express their identity, and this becomes increasingly relevant also for electronic accessories, such

as smart watches, which can now be customized in many ways in terms of both on-screen and physical appearances. With its initial focus on gadget-style artefacts to be mass produced for the broad market, the area has until recently been ignoring the cultural variety in style that dressing practices demand. The possibilities for styling e.g. mobile phones has been an important use practice, and will probably be even more so when it comes to electronic accessories worn even closer to the body (Juhlin et al. 2013).

Through the explorations presented in this paper we focused on how the value of an artefact could be shifted by combining jewellery with electronics, and a next step will be to look further into designs grounded in existing jewellery practice.

CONCLUSIONS

In this paper we presented a series of design explorations on the theme of interactive accessories that each combined electronics with handcrafting practices and materials that are predominant in fine jewellery. None of the designs presented here should be read as a proposal or prototype for future electronic product ideas, but rather as objects to reflect on current norms and potential alternatives when it comes to the design of, and our relationship to, electronic gadgets.

The four explorations presented in this paper were, a standard mobile speaker given an intricate physical form that combines electronics with leather, copper and silver, a simple physical button that uses the material properties of the metals as an interactive resource, a decorative garment that uses the conductive properties of metallic studs to control a sophisticated interactive soundscape, and an interactive hair needle that combines a wooden structure with accelerometer and light. Through these design explorations, and by studying jewellery as a practice in general, including aspects of materials, crafting and wearing, we became more aware of and concerned with topics related to the ways existing wearable and mobile electronics are made and worn. Additionally, we questioned how to approach the design space of interactive accessories from a jewellery perspective, and what could be learnt from such practice in order to better address the expanding cultural contexts in which technology is used.

The topics brought up in our discussion were a) the gestalt of electronic artefacts versus jewellery design, b) the concept of material preciousness, c) interactive properties of physical materials, and d) jewellery usage as an inspiration for new interactive designs. We see our main contributions as related to the gestalt of electronic accessories in terms of crafting properties and materials, but also insights on how the conductive properties of metals could be used as a material for designing electronic accessories, bridging the gap between formgiving and electronics. Additionally, we propose looking at electronic accessories from a perspective of an embodied fashion practice, including aspects of culture,

use contexts, style and personal meanings. In that way electronic products might be given new values, which could potentially increase their longevity. Challenges for the future concern how to better address the increasing need for varied designs, but also designing interactive accessories meaningful contexts and use settings.

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