

Designing for interpersonal connections in future technologies: An annotated portfolio of jewelry devices

Vanessa Julia Carpenter¹ and Dan Overholt²

¹Aalborg University Copenhagen, Technical Doctoral School of IT & Design
vjc@create.aau.dk

²Aalborg University Copenhagen, Sound and Music Computing
dano@create.aau.dk

Abstract

This work presents 4 design artefacts as an annotated portfolio, exploring how to design for tangible, non-screen jewelry devices which enable personal and interpersonal connections. We posit that these connections are key in furthering people's relationship with technology, beyond the basic functionality and efficiency of many so-called smart products today. To explore these connections, we have chosen to design jewelry devices as most traditionally crafted jewelry does not usually serve a particular functional purpose beyond emotional engagement, such as a wedding ring, an heirloom or a photo locket.

As wearables become more ubiquitous, we look to traditional craft to inform future designs and ask the question of which combination of technology and traditional craft can enable these connections and more meaningful experiences via our devices.

We explore related works in interaction design where traditional craft and technology has been combined and create an annotated portfolio of our designs as an attempt to exemplify qualities which are not typically tacit in the design of smart products.

Through reflection of each of the artefacts, the following four annotations are derived: 1) Desire as a driver of jewelry devices; 2) Engagement beyond useful functionality; 3) The current day novelty and importance of an app-less device and; 4) Using links to achieve deeper connections: people to people, a person to their sense of self, and a person to time (past, present or future).

This work contributes as a key insight, that in a time where 'smart products' are emerging in every domain, interaction designers can utilize traditional craft and the connections described in this work to influence and contribute to the thoughtful and thorough design of these future devices, helping create a future where technology enables richer interpersonal relationships.

Keywords: *Product Design, Jewelry Devices, Jewelry, Wearables, Craft, Rapid Prototyping, Emerging Interfaces, Meaningfulness, Smart Products*

1 Introduction

In recent years, exploration and creation of jewelry devices, smart jewelry, and uniquely designed wearables has increased its popularity in both interaction design and in commercial, consumer facing products (Golsteijn, Van Den Hoven, Frohlich, & Sellen, 2014; Tsaknaki, Fernaeus, & Jonsson, 2015; Tsaknaki, Fernaeus, Rapp, & Solsona Belenguer, 2017; Wallace, Dearden, & Fisher, 2007). A focus on craft in interaction design has been prominent (Tsaknaki, 2017; Padfield et al, 2018) and this combination of craft, interaction design, and technology helps to shape which products people might use in the future as we begin to adopt more and more smart personal wearables. This work aims to investigate this space, specifically focusing on designing for the personal and interpersonal connections for these future technologies.

Within commercially available wearables, the focus tends towards quantified self as can be seen by the market density of fitness trackers and health based devices (Vandrico, 2018). There are few current products on market which focus on personal (such as Thync, 2018) or interpersonal connections (such as the Hey Bracelet, 2018). Several take on the form of functional jewelry, as presented below in **Related Works**. Research within HCI (Human Computer Interaction) on the other hand, can be seen as promoting a variety of personal and interpersonal interactions such as design for self-development (Zimmerman, 2009), research which warns against technology which *limits* person-to-person connection (Cervantes et al, 2016), research which explores personal connection with the self (Núñez and Loke, 2017) or even interpersonal touch (Marshall and Tenant, 2017; Hoby and Löwgren, 2011). These examples aim to demonstrate the breadth of research within HCI about interpersonal or personal connection. This work aims to explicitly present four values which could be useful in designing for interpersonal or personal connections within future jewelry devices.

While the academic researcher might be familiar with designing for personal or interpersonal connections, there exists an opportunity to inform the design of new, intended-for-market wearable technologies which utilize jewelry design. Within this work, alongside jewelry designers and industry, we explored how we might design future technologies which consider personal and interpersonal connections while creating a traditionally crafted, smart product. From this, four qualities emerged and we propose this work as the beginning of a discourse about what future, on-market wearable technologies can be when they are designed for personal or interpersonal connection.

2 Framing the projects

In this work, four cases are presented: Trace, Mirror, Mirror, Connect and Fibo, all of which result from an 8-week long course in wearables as part of a professional bachelor program for jewelry, technology and business. The students were given a set of design challenges by the author who was leading the hardware development of the jewelry devices. Coming from a position in a product development and engineering company, the author chose these challenges based on a review of recent work within non-screen devices such as Rose's "Enchanted Objects" (Rose, 2014) Uglow's "Internet without screens" (Uglow, 2015) and Wakkary's "Morse Things" (Wakkary et al., 2017) where there is an increasing interest in everyday objects, enchanted by technology, which highlight qualities of subtlety, glance-ability (and non-glance-ability in the case of Morse Things). Further, given the vast array of available on market technology which predominantly utilizes an accelerometer and a screen (fitness or health tracking devices) the students were challenged to think past this parameters,

and imagine future technologies which might incorporate the following (these are the challenges):

- No screens – what might an app-less device look like?
- What other than light could be an output?
- How might you use interesting or unusual sensors? (What can humans not (easily) sense?)
- Could it be an heirloom device - or how could it exist as a sustainable solution?

The concept of heirloom devices and sustainable solutions emerged from discussions with the school about what the major challenges might be to people developing future technologies, such as sustainability of devices and avoiding planned obsolescence.

3 Research Through Design & Annotated Portfolios

This work presents 4 cases of jewelry devices which have acted as experiments to help deduce qualities about designing for personal or interpersonal connections. Hoby describes the annotated portfolio as “a way to communicate these qualities to a wider audience within design research” (Hoby, Padfield, & Löwgren, 2013). Gaver, in introducing annotated portfolios, explains: “Design, and research through design, is *generative*. Rather than making statements about *what is*, design is concerned with creating *what might be*” (Gaver, 2012). In this work, we are asking what might be. This is a method wherein design artefacts go through a process of “ideating, iterating, and critiquing potential solutions” (Zimmerman, 2007) and act as exemplars which reframe the problem. We use the jewelry devices produced by the students as vehicles for design research, leading us to reflections about how we might design future wearable technologies using jewelry design as a traditional craft technique incorporated with interactive technology.

Gaver presents annotated portfolios as “a collection of designs” which, when compared, act as “articulations of the issues, values and themes which characterize the relations among the collection” and which “maintain the particularity of individual examples, while articulating the ideas and issues that join and differentiate them” (Gaver & Bowers, 2012; Gaver, 2012). Löwgren describes that “annotations occupy some territory between the particular artifacts and the general theories” (Löwgren, 2013) and that this territory is “non-empty”, that it is occupied by “intermediate-level knowledge” which might be *patterns*, *concepts* or *experiential qualities*.

In this work, we utilize the form of an annotated portfolio to highlight the method of research through design wherein we have created early stage prototypes to discover *intermediate-level knowledge* and investigate emergent qualities and potential solution areas. We acknowledge the complexity of research through design (Redström, 2017) and state that this work is open ended. It invites a discussion of qualities designers might consider when designing for interpersonal connections in future technologies, especially within wearables. It reports on the findings which are a result of domain identification, user evaluations, early prototyping and user testing and reflecting on these designs. The ambition of this work is to invite a discourse around the proposed qualities and the challenges provided to the students in the design of these four works.

4 Related Works

4.1 Jewelry and technology

There has been a tremendous amount of work done in exploring traditional craft in HCI and we do not aim to cover it here. Rather we look to a few examples to gain insight into why jewelry has the potential to act as enablers of interpersonal and personal connections.

Tsaknaki et al have done a series of works exploring craft and HCI (Tsaknaki et al., 2015, 2017; Tsaknaki, Fernaeus, & Schaub, 2014; Vallgård, Boer, Tsaknaki, & Svanaes, 2016). They emphasize the aspect of time, things which last (Tsaknaki & Fernaeus, 2016), and explain that the “imperfections of current technology are used actively as a design resource, rather than a barrier for design”. The concept of something that lasts and design which incorporates flaws, can be clearly seen in jewelry design. Often, wedding rings or photo lockets might be obvious emotional jewelry pieces and Ahde-Deal, in her work on women and jewelry, (Ahde-Deal, 2013) uncovered some unique pieces, such as the ‘alewife pins’ – small dried fish made into pins which are worn on birthdays by a group of friends to represent an experience they shared. Jewelry has many meanings, to the artist who created it, to the wearer, to the one to whom it is passed down. Whether the jewelry has a functional purpose, an emotional significance or connects people over generations, jewelry has a certain power, (Ahde-Deal, 2013) and incorporating technology into it must go further than simply enhancing its functional purpose.

4.1.1 A functional purpose

A watch tells the time. A wedding ring or a photo locket serve the purposes of respectively, showing that one is married and providing a visual memory in the form of a photo. Aside from these functions, many heirloom pieces are emotional in their engagement. They represent something which evokes an emotional response, but otherwise lacks any specific function. The concept of functional jewelry is beginning to emerge within wearables as we see more and more ‘smart rings’ such as Motiv (“Motiv,” 2018), Oura (“Oura,” 2018) or alternatively, the BellaBeat Leaf, a necklace which measure fitness or sleep (“BellaBeat Leaf,” 2018). The topic of smart jewelry or jewelry devices has been explored extensively, such as explorations in material and form where there is a difference between interactive accessories and fine jewelry namely by the process of how they are created: “handmade using slow and time consuming crafting processes” (Tsaknaki et al., 2015). And Wallace et al, in their extensive work on jewelry devices, highlight the importance of “longevity and lasting personal attachment” as opposed to “reducing jewelry to the status of mere gadgets” (Wallace et al., 2007) and further, explains how we can use experience and sensuality to increase the richness of interaction with a jewelry object (Wallace, 2009). By focusing on the experience, we combine the functional (so-called ‘gadget’) aspect with the emotional (jewelry) aspect.

4.1.2 Designing desire

Desire in jewelry devices can be defined as both a desire to wear the device, and a desire to have an emotional connection to something, or someone. As Turner and Turner (Turner & Turner, 2013) explain, appropriation of an object, making it our own, or singularisation – the specialness of the object in the eye of the beholder are key factors in whether we are attached to our devices. Turner and Turner further reference *ensoulment* and *enchantment* and explain ensoulment as something that reflects the “owner’s identities and values” and enchantment as something which might enable future discoveries. Rose also discusses enchantment and

explains that enchanted objects can fulfil a “deep fundamental human desire in an enchanting way” (Rose, 2014). Desire may be thought of as an expansion of Wallace’s “enriching experiences”, beyond the physical or emotional engagement, and moving towards attachment, identity, and values.

4.1.3 Combining technology and jewelry to enable connections

In their paper on silver smithing, Tsaknaki et al present “basic material manipulations” (Tsaknaki et al., 2017) and explain how they used a variety of techniques to create sensors, which were hidden in the jewelry. These sensors became part of the jewelry, creating buttons or switches which were triggered predominantly by touch, as they explained that people typically ‘fiddle’ with jewelry and thus, a natural interaction was to touch the jewelry to interact with it. Finally, they presented a concept of ‘slow prototyping’ wherein the craft aspect brought forth “‘preciousness’ embedded in both the actual process and the artefacts resulting from a silversmithing process”. This preciousness was present in the projects presented in this work as the students are jewelry designers, and their first motivations centered around materiality, carefully selecting which materials they used and how they used these, even though we were only doing a few iterations of prototypes and not creating a final product.

Connections can also be established as linked between object, value and meaning. Jung et al (Jung, Bardzell, Blevis, Pierce, & Stolterman, 2011) explain that the links are what “really makes the difference”. We are particularly interested in the links between: **people to people, a person to their sense of self, and a person to time (past, present or future)**. The last link, to time, further echoes one of the aspects of the framework Wallace references, the *spatiotemporal* wherein one’s perception of space and time can change relative to the other aspects of emotional, sensual or compositional (see Wright et al in (Wallace, 2009)). In each of the below presented cases, we explain how we see these links.

A holistic understanding of the bodily engagement in combination with technology (and jewelry) are to be considered, as Höök et al describe: “technologies will (depending on how we design them) encourage certain movements, certain aesthetic experiences, certain practices and understandings of our bodies—while not encouraging others. They will influence our availability for certain qualities of interaction and not others.” (Höök et al., 2018).

This combination of exploration of traditional craft values (discovering through slow prototyping), links (between object, value, and meaning) and how the resulting design shapes how our interaction with technology will be (bodily, functionally, and in terms of desire, and connections) is what we aim to explore with the four jewelry devices.

5 The four jewelry devices



Figure 1. From left to right, Trace, Mirror Mirror, Connect, and Fibo. All functional prototypes. Images: Used with permission from @JewelleryofTomorrow on Instagram.

Here we present the four jewelry devices developed. Each was created as an answer to the proposed challenges, and each underwent early user research, rapid prototyping, jewelry production, and user evaluation. Each prototype was functional, using basic technologies to demonstrate more advanced future modalities so users could experience and give feedback on these early prototypes. The prototypes went through critique sessions with three advisors, one of whom is the author (external to the school), working with user centred design in hardware and product development, one (external to the school) who is developing medical devices, and one who is a jewelry designer and Associate Lecturer in design at the school. Each critique session was held with one of the advisors at a time, in person, or on the phone. Our ambition with this approach was to give the students feedback and the freedom to make their own decisions based on the variety of feedback they received. We acknowledged our role as co-designers (Eriksen, 2012) in this process; by giving feedback, guiding design choices and suggesting direction, we are inherently tied to the projects.

Below we present each concept, each prototype and how each relates to our described qualities of interpersonal connectedness. In reviewing the related works and reflecting on the links between: people to people, a person to their sense of self, and a person to time (past, present or future) we reflected on each of the four jewelry devices, determining which link was best represented by which jewelry device. This is not an arbitrary assignment of links to devices but rather a conversation, moving between what is obvious, what can be derived, and what emerges after comparing the four jewelry devices to each other.

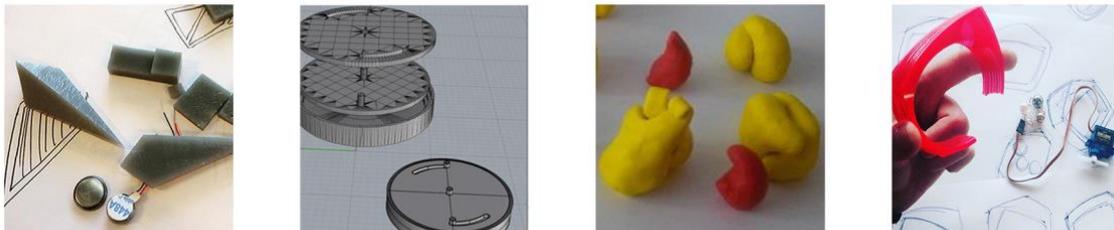


Figure 2. Early prototyping and material and mechanical exploration. From left to right, Trace, Mirror Mirror, Connect, and Fibro. Images: Used with permission from students.

5.1 Trace: Pointing to the special moments

Trace resembles the pointer of a compass, always “pointing to the special moments”¹. Trace consists of two parts: the first, the pointer of a compass, a wearable jewelry device which, in a future device, would contain a GPS unit and a vibration motor, vibrating when a traveler retraced the journey of a loved one and found places memorable to the loved one. The second part is a piece of jewelry which represents and is generated by GPS data points, so a journey could be kept, treasured and re-visited.

5.1.1 Trace Prototype

Rapid prototyping enabled us to quickly do early user testing with Trace. As such, the Trace prototype is simple and consists of a 3D printed case with a container for a coin cell battery, a button and a vibration motor. Using design probes, interviews and focus groups as techniques to gather feedback about the concept, it was discovered that Trace was appreciated as an in-use device; something one brings out to use when they go for a walk or hike. Users preferred this over a consistent use (daily) wearable which they were not as interested in.

¹ From the Trace student-produced catalog for their final exhibition

5.1.2 *Trace: Observations*

Trace was presented in the student catalogue as “It gives off a light vibration to the wearer to signify your routes aligning, enabling you to walk together and discover how your loved one moved through their journey whilst you experience your own.”² This transference of experience speaks to Wallace’s description of “longevity and lasting personal attachment” and highlights the experiential part of this jewelry. The compass portion is not something so precious, but rather, the sensation it gives, is.

*Trace is a representative of the link of **people and time** - connecting to a loved one’s past journeys, exploring new places in the current journey, and generating a piece of jewelry to be re-visited at a time in the future.*

5.2 **Mirror, Mirror: Focusing on the positive moments**

Mirror, Mirror aims to help women focus on the positive moments in their day. The group created an amulet which a woman touches when she experiences a positive moment in her day and at the end of the day, she can be reminded of her positive moment. One of the drivers of this concept was from the project’s initial user interviews, which showed that for many of the study participants, social media was a trigger of low self-esteem and took them away from being present in their everyday life.

5.2.1 *Mirror, Mirror Prototype*

One of the project ambitions was to: “make the jewelry look like an amulet and give it the power of positivity.” The front of the amulet is gold with a textured surface and three small precious stones. The back is a plate which rotates to open slits in the amulet’s surface. For the prototype and testing, a passive RFID tag was put into the amulet, and when a woman had a positive moment, she would rotate the back of the amulet to open it. When she came home, she put the necklace on a jewelry box, and the RFID tag was read, causing an LED on the box to light up, and reminding her of her positive moment. If the wearer did not experience a positive moment in her day, then the back was not rotated and the RFID tag could not be read.

5.2.2 *Mirror, Mirror: Observations*

Throughout early user evaluations, women interviewed were presented with three versions of Mirror, Mirror, each with a different surface and different sets of stones – this addressed the material choices. One commented “the simplicity of the technology in the jewelry is a really beautiful idea.”. The team concluded that “instead of stepping away from technology completely, you can use it to be present in the moment instead of living life through social media.”³. Mirror, Mirror was well-received; in prototype state, it could record one recognition of a positive moment and women agreed that in future versions, recording your positive moments (plural) throughout the day might lead them to think more positively in general.

*Mirror, Mirror represents the link between a **person and their sense of self**, how they reflected and opened to a more positive existence.*

² From the student’s diary log book during the project.

³ From the student’s diary log book during the project.

5.3 Connect: Re-establishing physical togetherness

Connect is a set of necklaces which two friends share. Connect consists of four parts - two identical necklaces which, when put together look as if they are small shapes, hugging one another, and a box for each. When the two friends physically meet, the necklaces are “charged up”. When the wearer is at home, they place the necklace on its box and the box emits light which fades over time depending on how much time has elapsed since the friends last met physically. Connect aims to disconnect from social media and focus on physical connections and being present in the moment.

5.3.1 Connect Prototype

A considerable amount of work was done to create these prototypes to ensure they were functional and realistic including casting and molding the shape, experimenting in different materials and in digital fabrication techniques to explore shape and to find out how light best permeates the surfaces, and experimenting with electromagnetism and LEDs to find out how the necklaces and boxes could work as a low-fi prototype. The final prototype consists of two necklaces which when physically connected, magnetically actuate a LED, and a box which houses a magnetic sensor, which activates a fading LED when the necklace is placed upon it.

5.3.2 Connect: Observations

The intention of the students was to “create a sentimental value, something to meet around and share”⁴. The materiality was important with Connect, the material had to be robust, but transparent, and something that was also aesthetically pleasing to wear to meet a friend. The Connect team was adamant that the necklaces were a stand-alone technology and did not connect to social media or quantify how often friends met, instead, it only focused on the next meeting. This was well received by the advisors as their sharp focus on the experience and material related strongly back to the focus on preciousness as presented by (Tsaknaki et al., 2017) and ensoulment and enchantment as per (Rose, 2014) and (Turner & Turner, 2013). *Connect represents the link between **people and people**, the formation, nurturing and growth of relationships.*

5.4 Fibo: A pregnancy wearable for partners

Fibo is a pregnancy wearable for fathers or for partners of pregnant women. Building on a near-existing product⁵ which monitors a baby’s movements, Fibo is a way for the father to experience the baby’s movements in real time. A band worn on the wrist contains four small balls of different sizes. When the baby kicks, pushes, or has hiccups, the partner can feel all these types of movements, in real time. In this way, the partner and mother of the child can share both the emotional and physical experience of the baby’s movements.

5.4.1 Fibo Prototype

The prototype began as a cloth bracelet wrapped around a vibration motor. The team looked to massage and sexual devices for inspiration and explored how pearls, metal balls, and round objects were consistently used in both ranges of products. They decided on a 4-pronged object with pearls at the end of each prong, driven by a miniature servo motor mimicking the baby’s movement. A metal casing with a leather strap contains the pearls, which press against the skin via a break in the casing where the leather strap sits. As Fibo is dependent on partnership

⁴ From the student diary logbook.

⁵ Bloomlife (<https://bloomlife.com/>) currently monitors contractions and is sold on the US market. Their future aim is to also monitor fetal movement: <http://www.mobihealthnews.com/content/bloomlife-gets-4m-wearable-pregnancy-tracker>

with a fetal monitoring patch company, the prototype is still in a hypothetical form wherein users *can* feel the movement on their wrist but the data driving the servo motor's movement is only an estimation of fetal movement, and not currently based on real data.

5.4.2 *Fibo: Observations*

In interviews, pregnant couples shared their excitement of the coming baby and stated that Fibo would be a great tool for sharing the experience of the movement. Many to-be fathers and partners were especially excited to be part of the third trimester, which might be culturally specific to Scandinavia, but nonetheless was an interesting observation. Mothers were eager to share the moments and thought that the movement of the balls was relatable to the movement of the baby. Fibo was proposed as a rental, to be rented during the third trimester only, so the aspect of longevity was instead expressed in a follow up conceptual ring which would represent through its shape, the baby's movements during the third trimester.

*Fibo represents the link between **people and people and a person and their sense of self**, as both the mother and partner share an experience that otherwise happens infrequently for the partner, namely, feeling the movement of the baby. Furthermore, we posit that it could cause the partner to reflect on their own role in the pregnancy and their connection to the baby and to themselves as they become a parent.*

6 Four Qualities for human-to-human and human-to-self connections:

Reflecting on these jewelry devices and the experiences which emerged from the design, development and deployment of these early prototypes, and referring back to the categories presented in related works, especially the links which create connections (Jung et al., 2011) we derived four qualities for personal or interpersonal connections:

6.1 Desire as a driver of jewelry devices

Desiring to be more connected to the baby (Fibo), to get away from social media and connect with friends physically (Connect), or to connect with a loved one through situated story telling (Trace) were aspects of desire as a driver. However, desire could be manifested in many ways. In Mirror, Mirror, a desire to move away from the negativity of social media and focus on one's own positivity created a new desire – to be more positive. Using desire, in the form of a personal ambition or an emotional aspect was one factor in each case which can be used to explore how jewelry devices can enable human connection.

6.2 Engagement beyond useful functionality

Useful functionality was one aspect of the jewelry devices. Using Trace, you can record GPS locations. Connect acts as a reminder to see a friend. Mirror, Mirror provides a diary function, recording positive moments. Fibo allows the partner to feel the movements of the baby. However, the resulting value, the emotional links (Jung et al., 2011) which emerge because of this functionality, is what makes each of these devices something more than just functional. Trace allows people to share memories and exchange experiences, to walk in someone's footsteps. Connect facilitates a physical meeting of friends, allowing for all the benefits of non-verbal communication to have a place and time to exist. Mirror, Mirror provides a tool to reflect on, and practice positivity. And Fibo helps to establish the partner's identity and enables stories between mother and partner (Carpenter & Overholt, 2017). By focusing on engaging the user, beyond the useful functionality of the device, or the data produced by a

device enabled us to focus on the experiential and emotional qualities which might emerge from using such devices.

6.3 The current day novelty and importance of an app-less device

Each of the devices was designed to be used without a screen. Although many wearables which do not have screens exist (“Hexoskin,” 2018, “Spire,” 2018, “Trago,” 2018), there are few which operate without dependence on an associated app. One example of a wearable which does not necessarily need an app is the Nokia Steel (“Nokia Steel,” 2018). It features two dials – one for the time, and one for the activity, showing the percentage of steps done in a day based on the user’s ambition for their daily activity. It is essentially glanceable (Rose, 2014), the user needs only glance at the watch to get the information needed. Thus, novelty exists in the concept of a device which does not require an app for feedback. Another example is Moment, a haptic wearable which uses haptic vibrations instead of a screen for notifications. (“Moment,” 2018)

With Trace, the jewelry device itself was first used to record the favorite locations of a first traveler and later used by a second traveler to feel a vibration when they were at the first traveler’s favorite locations. Connect required (and insisted upon) not having any app interaction, as they could easily have incorporated a meeting planning aspect into when two friends should physically meet, but designed instead for simplicity and subtlety, giving control to the friends to decide for themselves if they would revitalize the necklaces. Fibo, like the Nokia Steel, has an app, but only for data transfer as data from the mother’s wearable patch needs to be transmitted to a mobile phone which could then send it further via Bluetooth to Fibo to generate the movements. Mirror, Mirror was the closest to an app experience, as in this stage of the prototype, when the pendant was taken off and placed in its jewelry box, which lit up to show positive moments, and essentially behaves as an app might, acting as an information display. The potential for app-less devices is significant, and we ask ourselves as designers: how we can facilitate interaction and useful, timely information retrieval in a seamless, subtle way?

6.4 Using links to achieve deeper connections

For each case, we described how the links of people to people, a person to their sense of self, and a person to time (past, present or future) were utilized. We posit that these links can lead to designing for meaningful experiences, beyond the useful functionality of a device, without the use of an app, and using desire as a driver. By focusing on *people to people links*, we look to the relationship between people, how they grow independently and together. By focusing on *a person’s sense of self*, we provide an aid to potentially help them explore their identity, their personal development, and their values. And by focusing on *a person in relation to time*, we can help to facilitate a discourse on how they relate to themselves and others in terms of events which have happened, which are happening and which they would like to make happen. Many wearables report on what has happened or what is happening, such as a fitness tracker telling you how many steps you’ve taken today, or a heart rate monitor reporting if you are in the correct heart rate zone for your current goal and activity. However, few that we have encountered focus on the future, or on incorporate past, present and future to give a holistic overview of what is possible, probable or desirable.

7 Conclusion

This work presents four jewelry devices whose aim is to investigate how we might design for future technologies which enable richer personal and interpersonal experiences via non-screen, tangible interaction.

Related works in academic research point to works which demonstrate aspects of interpersonal or personal connection, however, related on-market consumer devices are predominantly focused on providing users with data they can act on, and are far less focused on how smart products (specifically, wearables) act a conduit to improved or enhanced connections between people or between a person and their identity.

Four jewelry devices, designed by jewelry designers, are representative of how traditional craft can be combined with interaction design to promote interpersonal and personal connections in wearables. These four devices demonstrate how the combination of jewelry and technology can be used to create unique experiences and opportunities for connection which go beyond facilitating an emotional bond (such as a wedding ring) or a functional use (such as a watch). The four devices include *Trace*: a way finding device linking people over journeys; *Connect*: a set of necklaces for offline connection between friends; *Mirror, Mirror*: a pendant for training positive thinking; and *Fibo*: a pregnancy wearable for partners of pregnant women.

Using an annotated portfolio to elicit issues, values and themes (Gaver, 2012) and to discover intermediate-level knowledge (Löwgren, 2013), we present four qualities which provide future designers and companies working with jewelry and technology with a potential starting point to explore and discuss this space. These four qualities are:

- desire as a driver of jewelry devices to form deeper connections between people and between a person and their sense of self;
- moving beyond useful functionality to also consider emotional links, stories, the formation of identity, and experiential qualities;
- the novelty of an app-less device, using the device itself to communicate information; and;
- using links between people, between a person and their own self and between a person and their sense of time to achieve deeper connections and a holistic overview.

This work encourages a discourse between interaction designers, jewelry designers, technology developers and product developers to discover how to create devices which truly engage people and enrich their personal and interpersonal relationships.

Acknowledgement

Many thanks go to collaborators on this project including: KEA, the Copenhagen School of Design and Technology was where this course took place. Petra Ahde-Deal, Docent at KEA, Nikolaj K. Nielsen, CEO, Sarita CareTech. And the students who created the projects including: *Trace*: Herine Tsui, Samantha Anahata-Hanson and Jolan van Duffelen; *Connect*: Vivian Stegeager, Christina Nielsen and Linnea H. Troelstrup; *Mirror, Mirror*: Cilia Kofoed, Sophie Krøll Heelsberg, Greta María Árnadóttir, Xinkai Huang, Jeffrey Zehngraft Kodua Kwarteng, and Nathalie Kim Tinggaard Larsen and *Fibo*: Sandra Pétursdóttir, Eszter Eva Smid and Henriette Ryder Andersen

Citations and References

- Ahde-Deal, P. (2013). Women and jewelry : a social approach to wearing and possessing jewelry. Aalto University publication series DOCTORAL DISSERTATIONS, 1/2013. Retrieved from <https://aaltodoc.aalto.fi/handle/123456789/11278>
- BellaBeat Leaf. (2018). Retrieved February 14, 2018, from <https://www.bellabeat.com/activity-tracking>
- Carpenter, V., & Overholt, D. (2017). Designing for meaningfulness: A case study of a pregnancy wearable for men. In DIS 2017 Companion - Proceedings of the 2017 ACM Conference on Designing Interactive Systems. <https://doi.org/10.1145/3064857.3079126>
- Cervantes, M., Ramani, R., Worthy, P., Weigel, J., Viller, S., & Matthews, B. (2016, June). Could the Inherent Nature of the Internet of Things Inhibit Person-to-Person Connection?. In *Proceedings of the 2016 ACM Conference Companion Publication on Designing Interactive Systems* (pp. 177-180). ACM.
- Eriksen, M. A. (2012). Material matters in co-designing: formatting & staging with participating materials in co-design projects, events & situations. Faculty of Culture and Society, Malmö University.
- Gaver, B., & Bowers, J. (2012). Annotated portfolios. *Interactions*, 19(4), 40. <https://doi.org/10.1145/2212877.2212889>
- Gaver, W. (2012). What should we expect from research through design? *Proceedings of the 2012 ACM Annual Conference on Human Factors in Computing Systems - CHI '12*, 937. <https://doi.org/10.1145/2207676.2208538>
- Golsteijn, C., Van Den Hoven, E., Frohlich, D., & Sellen, A. (2014). Hybrid crafting: Towards an integrated practice of crafting with physical and digital components. *Personal and Ubiquitous Computing*, 18(3), 593-611. <https://doi.org/10.1007/s00779-013-0684-9>
- Hey Bracelet. 2018. Retrieved from: <https://www.heybracelet.com/>
- Hexoskin. (2018). Retrieved from: <https://www.hexoskin.com/>
- Hobye, M., & Löwgren, J. (2011). Touching a stranger: Designing for engaging experience in embodied interaction. *International Journal of Design*, 3. p.p 31-48
- Hobye, M., Padfield, N., & Löwgren, J. (2013). Designing social play through interpersonal touch: An annotated portfolio. *Nordes 2013*, 1-4. Retrieved from <http://dSPACE.mah.se/handle/2043/15811>
- Höök, K., Caramiaux, B., Erkut, C., Forlizzi, J., Hajinejad, N., Haller, M., ... Tobiasson, H. (2018). Embracing First-Person Perspectives in Soma-Based Design. *Informatics*, 5(1), 8. <https://doi.org/10.3390/informatics5010008>

- Jung, H., Bardzell, S., Bleviss, E., Pierce, J., & Stolterman, E. (2011). How deep is your love: Deep narratives of ensoulment and heirloom status. *International Journal of Design*, 5(1), 59-71.
- Löwgren, J. (2013). Annotated Portfolios and Other Forms of Intermediate-Level Knowledge. *Interactions*, 30-34. <https://doi.org/10.1145/2405716.2405725>
- Marshall, J. & Tennent, P. (2017). Touchomatic: Interpersonal Touch Gaming In The Wild. In *Proceedings of the 2017 Conference on Designing Interactive Systems (DIS '17)*. ACM, New York, NY, USA, 417-428. DOI: <https://doi.org/10.1145/3064663.3064727>
- Moment. (2018). Retrieved from: <https://wearmoment.com/>
- Motiv. (2018). Retrieved from: <https://mymotiv.com/>
- Núñez Pacheco, C., & Loke, L. (2017, March). Tacit Narratives: Surfacing aesthetic meaning by using wearable props and Focusing. In *Proceedings of the Eleventh International Conference on Tangible, Embedded, and Embodied Interaction* (pp. 233-242). ACM.
- Nokia Steel. (2018). Retrieved from: <https://health.nokia.com/es/en/steel>
- Oura. (2018). Retrieved from from: <https://ouraring.com/#technology>
- Padfield, N., Hoby, M., Haldrup, M., Knight, J., and Ranten, M. F. 2018. Creating synergies between traditional crafts and Fablab Making: Exploring digital mold-making for glassblowing. In *Proceedings of the Conference on Creativity and Making in Education (FabLearn Europe'18)*. ACM, New York, NY, USA, 11-20. DOI: <https://doi.org/10.1145/3213818.3213821>
- Redström, J. (2017). *Making Design Theory*. The MIT Press.
- Rose, D. (2014). *Enchanted Objects: Design, Human Desire, and the Internet of Things*. Retrieved from: https://books.google.dk/books/about/Enchanted_Objects.html?id=Pkh6AwAAQBAJ&redir_esc=y
- Spire. (2018). Retrieved from <https://spire.io/>
- Thync. (2018). Retrieved from: <https://www.thync.com/>
- Trago. (2018). Retrieved from: <https://trago.co/>
- Tsaknaki, V. (2017). *Making Preciousness: Interaction Design Through Studio Crafts* (Doctoral dissertation, KTH Royal Institute of Technology).
- Tsaknaki, V., & Fernaeus, Y. (2016). Expanding on Wabi-Sabi As a Design Resource in HCI. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, (May), 5970-5983. <https://doi.org/10.1145/2858036.2858459>
- Tsaknaki, V., Fernaeus, Y., & Jonsson, M. (2015). Precious Materials of Interaction - Exploring Interactive Accessories as Jewelry Items. *Nordes'15*, 1(6).
- Tsaknaki, V., Fernaeus, Y., Rapp, E., & Solsona Belenguer, J. (2017). Articulating Challenges of Hybrid Crafting for the Case of Interactive Silversmith Practice. In *Proceedings of the 2017 Conference on Designing Interactive Systems - DIS '17* (Vol. 2, pp. 1187-1200). New York, New York, USA: ACM Press. <https://doi.org/10.1145/3064663.3064718>
- Tsaknaki, V., Fernaeus, Y., & Schaub, M. (2014). Leather as a material for crafting interactive and physical artifacts. *Dis '14*, 5-14. <https://doi.org/10.1145/2598510.2598574>
- Turner, P., & Turner, S. (2013). Emotional and aesthetic attachment to digital artefacts. *Cognition, Technology and Work*, 15(4), 403-414. <https://doi.org/10.1007/s10111-012-0231-x>
- Uglow, T. (2015). An Internet without screens might look like this. Retrieved from https://www.ted.com/talks/tom_uglow_an_internet_without_screens_might_look_like_this

- Vandrico. 2018. Wearables Database. Retrieved from:
<https://vandrico.com/wearables/wearable-technology-database>
- Vallgård, A., Boer, L., Tsaknaki, V., & Svanaes, D. (2016). Material Programming. In Proceedings of the 2016 ACM Conference Companion Publication on Designing Interactive Systems - DIS '16 Companion (pp. 149-152). New York, New York, USA: ACM Press. <https://doi.org/10.1145/2908805.2909411>
- Wakkary, R. L., Oogjes, D. J., Hauser, S., Lin, H., Cao, C., Ma, L., & Duel, T. (2017). Morse things: a design inquiry into the gap between things and us. Proceedings of the 2017 Conference on Designing Interactive Systems, 503-514.
<https://doi.org/10.1145/3064663.3064734>
- Wallace, J. (2009). Future interaction design II. In P. Pirhonen, A. Isoma, H. Roast, C. Saariluoma (Ed.), *En.red.ando* (p. 221). London: Springer. Retrieved from [http://www.xtec.es/~abernat/altres articles/videojuegos y alfabetizaci3n digital.htm](http://www.xtec.es/~abernat/altres%20articles/videojuegos%20y%20alfabetizaci%C3%B3n%20digital.htm)
- Wallace, J., Dearden, A., & Fisher, T. (2007). The significant other: The value of jewelry in the conception, design and experience of body focused digital devices. *AI and Society*, 22(1), 53-62. <https://doi.org/10.1007/s00146-006-0070-5>
- Zimmerman, J. (2009, April). Designing for the self: making products that help people become the person they desire to be. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 395-404). ACM.
- Zimmerman, J., Forlizzi, J., and Evenson, S. 2007. Research through design as a method for interaction design research in HCI. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '07). ACM, New York, NY, USA, 493-502. DOI: <https://doi-org.zorac.aub.aau.dk/10.1145/1240624.1240704>