The materiality of digital jewellery from a jeweller’s perspective

Nantia Koulidou\textsuperscript{1}, Jayne Wallace\textsuperscript{1}, Tommy Dylan\textsuperscript{1}

\textsuperscript{1} Northumbria University, Newcastle Upon Tyne, UK
nantia.koulidou@northumbria.ac.uk

Abstract: Taking a research-through-design with craft sensibilities approach we present design proposals in the digital age that value the complexity and uniqueness of being human. We introduce exemplars of digital jewellery objects that offer alternative ways of connecting a person with personal anchor points, significant others and places. The pieces were inspired by the lives of three participants and the researcher who all frequently travel back to their native countries, but who live permanently in the UK and experience feelings of transition and what we describe as “being in-between”. ‘Microcosmos’, ‘Togetherness: Connected Brooches’ and ‘Topoi’ expand our understanding of what digital jewellery can be by embodying interactions that highlight the sensorial and imaginative aspects of digital technology.

Building on our previous work on poetic qualities of interaction with digital jewellery we offer a reflective view on how digital jewellery can challenge our expectations of digital connectivity, sensor functionality and location awareness and we discuss the material qualities of the pieces by unfolding the narratives associated with their function and form.

Most digital devices come with a set of expectations such as: What does it do? How long is battery life? How cutting edge is the technology? By contrast, this research offers a focus on atypical personal interactions in order to address a different range of questions and potentially open up our expectations of the digital. By reflecting on our designs we continue the discussions on how jewellery practices and digital technologies can suggest more poetic interactions for people.

Keywords: digital jewellery, poetic interactions, sense of self, micro-transitions, craft, digital technology, contemporary jewellery

Method & Critique
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We correlate the following logic of what De Landa (2001) refers to as a technological deterministic, where technologies of innovation are looking for the next, expected level of evolution. This reflects a functionalist prejudice that technology is always in the present (Ryan, 2014). Activity monitors for fitness purposes can be “always on” to provide the wearers with detailed information on their everyday practices; count steps, measure heart rates and record biosensory data in real time. Arguably, most of the existing examples of wearable technology rely on technological solutions that focus on functionality and efficiency.

The body and the data it represents has become central on issues of wellbeing and selfhood (Lupton, 2014). From an industrial perspective, combining as much data as possible is the key to understanding the over our minds and bodies (Sullivan, 2016). Hundreds of apps have been developed for achieving digitalised self-tracking and Wolf and Kellei (2007) list over 500 self-tracking tools including geolocation, health, fitness, weight, sleep, diet and mood or feeling tracking apps. Several authors have called into question the aim of wearables to track health, fitness, weight, sleep, diet and mood or feeling tracking apps. Kellie (2007) lists over 500 self-tracking tools including geolocation, health, fitness, weight, sleep, diet and mood or feeling tracking apps.

We use the terms ‘wearables’ and ‘wearable technology’ interchangeably, following (2017), who defines wearables in terms of display and functionality. Wearables are products worn by subjects whom intelligent systems sense and manipulate.

Digital jewellery refers to Jewellery pieces with embedded electronic components (Kettleby, 2008; Wallace, 2007). In the research digital jewellery is described and has not referred to its purpose as accessory, but in its capacity to represent highly personal emotional meanings and convey a range of concepts related to being human (Smith, 1978), taking advantage of the increasing potentials of digital technology in sensory functionality, connectivity and location awareness.

A micro level transition is concerned with experiences, narratives and meanings in a personal setting (see more Höök, 2013). More broadly describes the field as “madly devoted to articulating facts through numbers” (p.23). Morozov (2013) more broadly describes the landscape of digital technology and its interconnectedness with our bodies and minds (Sullivan, 2016). Hundreds of apps have been developed for achieving digitalised self-tracking and Wolf and Kellei (2007) list over 500 self-tracking tools including geolocation, health, fitness, weight, sleep, diet and mood or feeling tracking apps. Several authors have called into question the aim of wearables to track health, fitness, weight, sleep, diet and mood or feeling tracking apps. Kellie (2007) lists over 500 self-tracking tools including geolocation, health, fitness, weight, sleep, diet and mood or feeling tracking apps. Several authors have called into question the aim of wearables to track health, fitness, weight, sleep, diet and mood or feeling tracking apps.

First author designed digital jewellery pieces that aim to support self reflection and changes to one’s sense of self during such journeys. For this research, the first author worked closely with the participants and the design researchers born in different places in the world, but who currently lived and worked in the UK and periodically traveled back and forth to her home country where she has had during these journeys that highlighted this as part of time and particular travel journeys and the shift between what her identity is more obvious to her and pronounced.

This doctoral research was framed to understand and investigate both if/how this context is experienced by others and if/where there are opportunities for digital jewellery to support fluctuations and changes to one’s sense of self during such journeys. For this research, the first author worked closely with the participants and the design researchers born in different places in the world, but who currently lived and worked in the UK and periodically traveled back and forth to her home country where she has had during these journeys that highlighted this as part of time and particular travel journeys and the shift between what her identity is more obvious to her and pronounced.

In the research, the first author drew upon her personal biography and her own experiences to explore what it means and feels to be a person during a micro-transition and she brought insights from her explorations into the participatory engagements with others in the broader context of design research. Situating the research within the broader context of experience-centred design, she drew heavily on McCarthy and Wright’s (2015) understanding of dialogue to guide her methodological decisions on the participatory part of the work. To build a relationship with the participants that is rooted in trust, empathy and sensitivity to the context. Building upon existing methods in design to understand lived experiences (such as probes and theatre methods), the first author opened up a creative space for participants to share aspects of a sense of self with the researcher (see more: McCarthy and Wright, 2017a, 2017b) in which we used to develop a mutual responsive engagements where both participants and the researcher can benefit from the participation. The participatory engagement lasted for a period of two years and participants were encouraged to contribute to the research in ways that they felt right to them. The work started with an initial meeting with each of the participants (that included all participants) and a number of one-to-one meetings. In those meetings, we shared opportunities for digital jewellery while reflecting on how such objects could support our transitional experiences. Inspired by the lived experiences of the participants, her own experience of travelling and conversing with experts in aviation, the first author designed digital jewellery pieces that aim to support self through micro-transition, but this is not to over stress the point that these pieces are valued by others in the context of the research and not to achieve this. The pieces acted instead as design propositions within a small group of experts (in the field of digital jewellery) to discuss the potential of digital objects in personal interactions with the aim to open alternative ways of looking at the potentials of digital technology within jewellery practice. Such a triangulation gave the first author a more detailed and balanced understanding of the data by responding to the objects. This approach reflects on the role of artefacts in exploring new design spaces. For example, Lim et al. (2008) offer an extensive discussion of prototypes in design, defining prototypes as “filters that traverse a design space” (1994:36) and that have the potential to support self-reflection and changes to one’s sense of self during transitions (p.7:3). Wensveen and Matthews (2014) used the term “research archetypes” to refer to prototypes that “are embodiments of research concepts or perspective that have broad application, but also that require specific examples to demonstrate their potential and justify that they constitute a contribution” (p.268).
Digital Jewellery: Narratives of Form and Function

This section presents three digital jewellery pieces that resulted from the research: Topoi, Anthos and Chronos Brooches.

Within each sub-section, we start with the description of the piece, followed by detail of what inspired each of them and the design development stages. We also included the first author’s reflections-in-action during the making phases. We have chosen to describe this part of the work in the first person to echo the personal practice nature of the work.

Working with the digital

The making of the digital part of the prototypes were designed in close collaboration with a creative technologist (third author). Throughout the making of the pieces, we used the Arduino platform for its accessibility and ease of use for artists and designers. This allowed me (first author) to directly manipulate and experience the prototypes.

Throughout the research, I was driving the creative decisions by responding to the third author’s suggestions regarding hardware and their suitability. I was able to iteratively respond to changes creatively and develop an understanding of what I wanted to achieve. In that way, working with the digital became part of my own reflective material practices.

Topoi: a piece of digital jewellery

Description of the piece
Topoi is a hand-held piece of digital jewellery containing tiny microfilm images from two countries that are significant to the owner. The piece is composed of a digital and a non-digital element. The digital part resembles a rock formation that is made of modelling putty with embedded crushed coal and oxidised silver. Within the piece are electronic components (which I will describe later) and layers of microfilm which are visible through a viewing window made from the edge of a found thimble (see Figure 1,2). The non-digital part of the piece is a magnifying lens mounted in a silver frame, with a handle made from a found teaspoon. This lens allows the owner to look into the rock shaped form visible, but by activating the internal LED light, the person can view the other images on layers, which appear and recede, by manipulating the magnifying lens. This gives the opportunity to peek briefly through the glass and interact with the images in short bursts, before the light fades gradually again.

Concept Inspiration

The concept arose from the design engagements with all three participants where discussions focused particularly on the value of meaningful connections from both countries and the dynamic notions of home. In particular, Topoi was inspired by one of the participant’s (Laura) lived experience of travelling between two countries and her reflections on changes to sense of self during such periods. I was thinking about Laura when making this piece and that if she looked through the magnifying lens, she would be invited to blend the images, bringing to the fore certain aspects of home and senses of self in both countries. The piece also draws on inspiration from the context of miniatures. When something is represented in miniature it often creates a particular kind of intimate interaction that is private and uncommon in our everyday public life (Stewart, 1993). The miniature “skews the time and space relations of the everyday lifeworld, and as an object consumed, the miniature finds its use value transformed into the infinite time of reverie.” (p. 65). Stewart suggests that viewing a miniature creates the space to allow one to spend time with oneself, which could be highly valued during micro-transitions.

Design Development

As is the case with all of the pieces that were made as part of this research Topoi was not made specifically for one of the participants and was in fact inspired by the creative conversations and design workshops with all of the participants. The form of Topoi draws inspiration from Laura’s love for mountaineering however, and the images within the piece do connect with things that Laura shared about her life. The selection of the images reflects the significance of nature to her life in both countries. The piece also draws on inspiration from the context of miniatures. When something is represented in miniature it often creates a particular kind of intimate interaction that is private and uncommon in our everyday public life (Stewart, 1993). The miniature “skews the time and space relations of the everyday lifeworld, and as an object consumed, the miniature finds its use value transformed into the infinite time of reverie.” (p. 65). Stewart suggests that viewing a miniature creates the space to allow one to spend time with oneself, which could be highly valued during micro-transitions.

In that way, working with the digital became part of my own reflective material practices.
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From a craft perspective, it was interesting for me to explore the materiality of the film and its interactive qualities and how these attributes could inform my practice. In an overexposed photo, for example, the images were turned into black silhouettes, which was a good asset for masking or simplifying details of personal information, such as specific features of a person in an image, and instead creating a stylised image that would still be recognizable to specific viewers, but more abstract and representative of a human (rather than a specific person) to other viewers. I also discovered that the positive and negative images on microfilm could be viewed as layers of the same image (see Figure 4), allowing someone to blend certain parts of the pictures with another image.

Figure 4 shows the development of the working prototype. For the first prototype, I integrated a temperature sensor (TMP36) with the SparkFun RedBoard (see Figure 5a). I was thinking that the LED light could respond to the temperature of the hand, however, the cumulative effect of the ambient temperature and the variations in temperature of my hand but made it difficult to return consistent results. The third author advised me to look at the Teeny 3.2 board (see Figure 5b). This board supports a hardware-based capacitive touch sensing circuitry on specific pins, which offers much faster measurements with better stability over temperature variation. To run the code on the Arduino board, I downloaded the Teensyduino software as an add-on for the Arduino Software and I used the touchRead() command to read the capacitance on the pins. In terms of the interaction, I paid close attention to the length of the fade and the dim of the LED light after the piece having been touched. This was done through trial and error, were the third author wrote the code in a manner that allowed me to test and iterate these changes.

Alongside the interaction, I was experimenting with the form of the piece. Figure 6 shows my initial ideas to use found limpets as a reference where the idea of the piece comes from. From a craft perspective, it was interesting for me to explore the materiality of the film and its interactive qualities and how these attributes could inform my practice. In an overexposed photo, for example, the images were turned into black silhouettes, which was a good asset for masking or simplifying details of personal information, such as specific features of a person in an image, and instead creating a stylised image that would still be recognizable to specific viewers, but more abstract and representative of a human (rather than a specific person) to other viewers. I also discovered that the positive and negative images on microfilm could be viewed as layers of the same image (see Figure 4), allowing someone to blend certain parts of the pictures with another image.

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Alongside the interaction, I was experimenting with the form of the piece. Figure 6 shows my initial ideas to use found limpets as a viewing window. For clarity, limpets are sea shells that live by attaching themselves to rock surfaces. My thinking was that limpets was a nice metaphor as they make an indentation in the rock (called a home scar) on which they live and although they move around to feed they always return to the same indentation. In metaphorical terms, the owner returns to the same place to look for comfort and connect with home. However, opening a hole on the shell was challenging as the shell was brittle. Instead, I decided to use one of the found thimbles as a reference where the idea of the piece comes from.

Concurrently, I was working with air-drying clay and later on with the milliput epoxy resin putty (black colour) to find the rock-like form of the piece. I made a number of prototypes for form-finding and when I had the final electronic components I made the final form. I left extra space inside the piece for the electronic components, but I did not consider the extra space for the JST connectors which is required to attach the battery to the board. Figure 3 (p.7) shows the final form of the piece with the enclosed the electronics and layers of film.

Microcosmos:
A piece of Digital Jewellery for the Airplane

Description of the piece: Microcosmos is a hand-held piece of digital jewellery containing a 16mm microfiche image that can only be accessed during an airplane flight. The image depicts an image of a potent text that is significant to the person. The piece is made of found objects, silver and velvet fabric (see Figure 7a,b). Enclosed within the found tin are the magnifying lens, the tiny image and the electronics (Arduino nano 3.0 board, BMP180 Barometric Pressure Sensor, an LED light, push button and a lithium battery). The handle, made from a found spoon, acts as a slider allowing the person to move the lens up and down, while the velvet fabric covers the opening of the slider to ensure smooth motion and minimum light inside the piece. Below the slider there is a push button; once the button is being pressed down the electronics start measuring the air pressure in the environment. The viewer, made from the edge of a found thimble, allows the person to view the film that is located at the bottom of the piece, when light comes through.

As the plane reaches its maximum altitude (approx. 30.000 feet), an LED light inside the piece gradually illuminates allowing the individual to manually focus on the text by moving the slider. After the take-off, the cabin pressure gradually drops until it stabilises again as the plane climbs to the cruising altitude. The light then stays on until the sensor detects a significant increase on air pressure, which indicates that the plane begins to descend (dropping its altitude for landing). Consequently, the light starts fading out, allowing one to view the image one more time for this journey.

Concept Inspiration: The pieces arose from discussions with the participants on the value of having a personal time to be with oneself during the flight and to feel comfortable with the change. Diane and Jude shared their reflections that their feelings of transition are very important, which is potentially of high value during the flight journey. The piece responds to the changes in the environment giving the opportunity
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when I visited home for Christmas in 2017. This prototype was taken and tested during two flights and I made adjustments in later stages of the process. To see if the piece responded to this threshold and the LED illuminates.

For the interaction I needed to understand how the pressurisation in the cabin works in order to set the parameters for the barometric sensor. In order to more fully understand the dynamics of cabin pressure I interviewed a pilot in the cockpit of the plane during a flight to Greece. During the take-off the cabin is pre-pressurised at a rate of 100 ft/min (30m below the sea level) to avoid discomfort for passengers and crews. During take-off the cabin is pressurised gradually during the climb phase until the plane reaches its cruising altitude. At typical cruising altitudes in the range 11,000–12,000 ft (3600–4000 m), the air pressure in the cabin is equivalent to the outside air pressure at 1800–2400 m (6000–8000 feet) above sea level which is approx. 1.6–2.4 atm (interview notes). From this and to explore the interaction. Similar with the piece Topoi, the viewing space is made from the edge of a found Stanhope thimble.

For the first prototype, we connected the sensor with the Teensy 3.2 board, a BMP280 Barometric Pressure Sensor and an LED light (Figure 15). The third author wrote the code for this prototype and I made adjustments in later stages of the process. To see if the prototype was working, we tested it in an elevator, by changing the pressure threshold to be equivalent for 40 metres (Figure 16). After a few trials and errors, the light was fading in above a certain height and fading out respectively. For the first prototype I had a push button were the same ones we used for the first prototype.

Figure 10. Cross sections of layers of coloured resin. Developing the Chronos Brooches. Photos: Nantia Koulidou

Togetherness: Anthos and Chronos Brooches

Description of the piece: Togetherness is suite of four brooches. The first elements are a pair of digital brooches ‘Anthos’, meant for two wearers - each living in a different country (see Figure 11). They are made from 3D printed wood filament, a found twig, silver and electronic components. The second element of the suite is a further pair of non-digital brooches ‘Chronos’ made (as we will describe further) as a result of the data collected from how the first pair of ‘Anthos’ brooches are worn. They are composed of a twig, layers of coloured resin and stainless steel (see Figure 9).

Two people each wear one of the Anthos brooches over a period of time and as they do so the electronic components within each brooch (Tinduino boards - a real time clock, processor with battery support, a USB shield, a protoboard, an SD card and a 140mAh lithium polymer battery) capture time and date data comprising how long and when the brooches are worn. Each Anthos brooch is constructed such that once the silver brooch pin is fastened (i.e. when someone pins it onto their clothing) the electronic circuit is closed, and the data is stored and recorded. As such the brooch pin itself acts as on/off switch in the electronic circuit.

After the two people have worn the Anthos brooches for a period of time (designated by them) the SD cards are removed and the stored data is used to inform the composition of the new Chronos brooches. Chronos were made by using another portion of the twig used in the Anthos pieces and dipping this into pots of coloured resin in response to and guided by the data of how long the Anthos brooches were...
Concerto: The pieces arose from the design engagements with two of the participants and my own lived experience. Discussions focused particularly on attempts to find ways to connect with loved ones over distance in subtle and indirect ways and the significance of these connections during a journey back home itself. From talking with the participants and from reflecting on my own experiences I understood that “each journey has its own story” based on the complexities of life and events in people’s lives. I reasoned that there were opportunities to capture the experience and feeling of a specific journey and that this could be valuable.

Design Development: The Anthos and Chronos brooches are made from the same tree twig (see Figure 12). The 3d printed part of each Anthos piece resembles a flower bud, which has references to time and growth. They are made from the same tree twig made into the new Chronos brooches (see Figure 10) and the forms are similar, but not the same; they have subtle variations in colour (see Figure 13). The size of the electronic components informed the size of the 3d printed form. Small variations in size where necessary to find out the best fit of the components. Before I move on dipping the third piece of the tree twig (used on the Anthos Brooches) I experimented with other forms and fillers to find out a system that I could use later on in the process of the Chronos brooches.

The side of the bud that faces down (when the piece is worn) is open, leaving the electronic components visible (see Figure 11). This decision was taken for two reasons: a) to acknowledge that the electronic components are part of piece and b) to unplug and recharge the battery. It is uncommon for jewellery that electronics were championed and visually part of the piece. Although they are not overt and you have to look up inside the wooden printed buds to see them they are evident and are also somewhat vulnerable in the piece, as they are not encased. My rationale was that a wearer would be fully aware of the electronic components in handling and wearing the piece and that this would heighten the awareness that the jewellery was capturing data of wear and that there was a preciousness to this, echoed in the vulnerability of the components.

For the Anthos Brooches, we used the Tinyduino boards (a real time clock, processor with battery support, a USB shield, a protoboard, an SD card and a 140mAh lithium polymer battery). The third author helped me with the code in first place, but in later stages of the prototyping, I was able to add lines of code when necessary. For all prototypes, I used the Serial Monitor (a function in the Arduino Software). The Serial Monitor was really important as a beginner in understanding what was taking place and having a more direct software). The Serial Monitor on the Arduino software. Testing the prototype using the Serial Monitor on the Arduino software. Photo: Nantia Koulidou

My first experiment with the 3d printed wood filament was during a workshop at Fab Lab Berlin in 2015. I was intrigued by the result of the 3d printing as the layers of material were subtle. The piece had the smell of wood and a very smooth texture to it. When I started experimenting with the same material myself, I found out how the printed object varies in colour and texture, depending on the temperature and the speed of the printing. Sections could appear scorched and darker if the filament was heated too much or printed too slowly. These gentle variations in colour inspired the aesthetics of the Anthos brooches. I wanted each Anthos brooch to be unique, but at the same time to be visually part of the whole. The final forms are similar, but not the same; they have subtle variations in colour (see Figure 13).

Digital jewellery Challenges Existing Conceptions of Digital Connectivity

In the previous section we described the narratives of the form and function of three pieces of digital jewellery Topoi, Togetherness: Anthos and Chronos Brooches and Microcosmos. Building on our previous work on poetic qualities of interaction with digital jewellery (Koulidou, 2018, Oliver and Wallace 2009, Wallace, 2007), in this section we offer a reflective view how the digital jewellery we present in this paper challenges our expectations of digital connectivity.

Topoi introduces an interaction with layers of microfilm images from places that are significant to the individual from both countries that one can view only in short bursts. The digital in the piece enables a personal space where one can enter, when one decides. The personal data is hidden in the piece and nowhere else, offering a controlled space where one can explore aspects of herself or himself in private. Only you have access to the piece. We can think of personal space as a way of allowing people into it as a form of permission that is granted by the wearer. In Topoi, it is not just about permission, the digital jewellery itself might only function when connected with a wearer. Thus, we can consider the wearer to be a type of key that allows access to the piece. Topoi is activated when one decides, offering a controlled space where one can explore aspects of herself or himself in private. The gesture of holding the piece tightly is a prerequisite for the interaction. The body in this instance becomes an active part of the piece; its power source in metaphorical terms, suggesting a sensorial interaction. The personal data is hidden in the piece and nowhere else that one can view only in short bursts. This time-specific interaction brings the attention to the person and the connection between the piece, the body and its meaning for the wearer. Togetherness suggests an indirect and non-intrusive way of connecting two significant others, where the digital enabled the
creation of a new piece that signified a trace of a relationship. In this instance, the digital brooches become the medium to create new forms of jewellery through meaningful encounters. Two people might have shared a piece of gum in each other’s birthday day and they know that the third piece is made as the memento of that day. Thus, people can be actively part of the creation of the piece in a very playful way. The Anthos brooches allow us to think more critically about current examples of wearable technology that is continuously measuring and monitoring activities. When the pieces are activated, they capture time and duration being worn on the body much like other wearables that track a user’s activity. However, they differ from existing wearable technology as the pieces are not worn as an additional app, nor they are connected to an explicit digital platform. There is no explicit coordination that is actually telling the wearers of that implicit “togetherness” and the physicality of the third piece would not exist without the co-created experience. The Anthos brooches through an ambiguous connection suggest an indirect form of communication between two people. The wearers do not get any feedback if the other person is wearing the piece, leaving room for emotional engagement. The Chronos brooches are unique and tethered to a specific period of time when the Anthos brooches were worn simultaneously. The data gathered over time are interpreted by a maker in a very open and imaginative way, allowing room for further interpretations.

Microcosmos introduces a similar interaction with the piece Topoi, however, the digital in this piece enables a personal space where one can enter; when the environmental conditions are right. The owner has no control over the interaction which introduces a very different dynamic to other digital objects we encounter. The owner knows that the personal data hidden in the piece are there and nowhere else. This very controlled interaction has elements of ambiguity, as the conditions are not always the same in each flight and the owner does not know the exact time of the activation. The environment of the plane can be considered as a form of control for digital jewellery. The specificity of the interaction adds value to the interaction and the space where it happens. Knowing that the piece will function at some point in each flight even for a short period of time, invites someone to wait for the interaction. This creates anticipation, which can be seen as an attribute of digital jewellery. Microcosmos functions only during a flight, offering a site-specific and time-limited interaction. From my (first author) reflections on the interaction with the piece during the flight, it became clearer how personal space to connect with the data inside the piece in an intimate way. Looking through the lens brought my body closer to the content of the piece in a physical way, introducing a sensorial interaction. I enjoyed the fact that I knew the piece would work for a certain period of time. I was not sure of the exact time, but this lack of precision made the interaction more exciting and my anticipation was heightened.

The Value of Digital Jewellery as Single Function Digital Objects
Digital jewellery often functions for a limited period of time (Topoi), in a specific place (Microcosmos), or under certain conditions (Microcosmos, Togetherness). For example, a capacity sensor is enclosed within Topoi and data from the sensor becomes the input for the illumination of a LED. Microcosmos responds to data retrieved from a digital app, and Togetherness, each Anthos brooch acts as a switch mechanism that allows each brooch to store the time and date when the piece is worn. However, what is important is that these functions can potentially trigger personal interactions for the wearer in an often subtle way. One could argue that the digital functionality of the pieces presented in the paper is very limited in comparison to other examples of digital functions usually found in mass-produced wearables. We suggest that if makers understand digital technology as being another material for design with its qualities and limitations (such as those limitations associated with wood or silver) then they should have the freedom to choose the digital functionality they find relevant to their concept. The more makers understand the potential of the digital through making, the more they learn how to manipulate it (the digital) through experience. These examples of digital data and interactions can be re-composed over time, but this is not to fixate that this an ultimate goal of making digital jewellery. The jewellery pieces presented in this paper offer simple interactions if we look at the technology alone, however this does not mean that the interaction with the piece cannot be highly significant for a person.

We highlight that digital jewellery are often single function digital objects; they are crafted, tailored and personal. Wallace et al. (2018) articulates that there is personal value in the bespoke and one-off digital design artefacts. Concentrating on a single function allows makers to sidestep the noise that comes with functional complexity and directly address how these pieces could be meaningful on a personal level (ibid.). In designing digital jewellery makers can design artefacts that are single function objects and “much more than its parts” (p.423), allowing the maker to think of their poetic potential within people’s lives in enriching ways. The digital jewellery pieces we presented can be seen as counterpoint to existing examples of wearable technology with “the increasing level of interaction complexity” (ibid, p.423). In its conception, digital jewellery seeks to discover significance beyond the functional. In this conceptual space, Wallace et al. (2018) argues for the role and value of craft as a methodology in designing digital objects that are bespoke and tailored.

Manipulations and Representations of Digital Data from a Craft Perspective
The consequences of computer-aided (CAD/CAM) and digital fabrication processes (3D printing, laser-cutting) enabled new opportunities for designing jewellery outside the field contemporary jewellery. Companies (see for example Makkoo, Nervous.com) offer a wearer the possibility to design their piece of jewellery and personalise it based on their input. The notion of democratising access in the design process in one of the main advantages of this technological phenomenon (Bernabei, 2014), however, taking a more critical view, the wearer’s involvement is limited to pre-defined parameters. The code has limitations and I wonder how democratic is this approach? On the contrary, The Anthos brooches invite people to create a new piece in an unpredictable way. Two wearers can acknowledges and share their experiences of the things that are meaningful to them. People can be actively part of the creation of a new piece in a very playful way. This experience reminds me of Ted Noten’s participatory project Chew your Own Brooch (1998) that gave the participants the creative influence on the end product alongside the anxiety of being an artist for a few minutes. Each participant chews a piece of gum (which he or she then forms into a shape) and sends it back to a jeweller. Each piece was then casted into silver or gold and sent back to the participants. Even though a jeweller is involved in the making of the final brooch in the Chew your Own Brooch piece, he/she does not have an active role in this process. Togetherness gives the opportunity for both wearers and makers to be creative in their own right and influence the final Chronos brooches.

There is a great of potential for makers to use digital data created by people during meaningful encounters as a material within their practice and to think of creative ways that data (data of use or biometric data) can be interpreted and shared in ways where people can add their own meanings. This is not a new form of interaction. People used to codify messages in jewellery for many years. In Georgian times (early nineteenth century), for example, gemstones were used to encode messages. The first letter of the gemstone and the different colours of the gemstones could be decoded by the wearer (Luthi, 1998). Similarly, Chronos brooches represent an encoded message that only two wearers can best interpret. This message is just about them and the time they were connecting with each other through the Anthos brooches. The piece, therefore, offers an interpretation of encoding meaning in jewellery in a contemporary way.

Interaction with wearables are often fast paced and people expect to read data retrieved from a wearable device in seconds or create a piece with digital fabrication methods because it is easier. I could have taken the data from the Anthos brooches and printed a 3D form instead of making a piece from resin. My reasoning was that I wanted to represent time in a physical and slow way and thus, synthesize the activity between the wearer and the brooch. It takes time to make each layer of Chronos. One has to wait long enough for one layer of resin to set in order to create another layer. The thicker the ring, the longer the setting time and the longer the time the Anthos brooches were being worn by two people. This process includes an open interpretation of data. The fact that the interaction with the Anthos brooches is time-limited and also ambiguous suggests that digital jewellery interactions could also consider moving away from well-defined measurements (such as heart rate and step counting) and move towards more subjective visualisations of data which can be interpreted from a craft perspective and not from a pre-defined algorithm. We see a great potential within craft practice to design pieces that are made because of two other pieces being worn.

Conclusion
The relationship between jewellery practices and wearables research is often debated and, at times, polemic. One component of this relationship that has not yet been widely investigated is the role of digital jewellery as an emerging field within contemporary jewellery practice. The field of digital jewellery is misunderstood and often it is neglected by the contemporary art jewellery world due to its close relationship to wearable technology and the code that is embedded within commercial applications. We see a great potential in craft practice to design Artefacts that are made because of two other pieces being worn.

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technology, this thesis is not intended to be reactionary. We should be concerned when people talk about wearable technology and digital jewellery as if the terms are interchangeable. However, just as we worry about a focus on technological evolution, so too should we be concerned with research that looks for alternative uses of digital technology. We believe that digital jewellery (within the field of wearable technology) is undervalued. Arguing for a fundamental reconfiguration of our understanding of digital jewellery, this research suggests that there exists a rich conceptual space for jewellers when they start thinking about “the digital” as a material that can be adopted for use within their practice. Our argument, however, is not an attack on wearable devices or other technological developments. We do not dismiss the many advantages of current digital technology such as smart phones or healthcare devices – it is simply that there are different concerns of this phenomenon, and that as makers/designers/jewellers we should look more closely at our own interpretations of materials such as the digital.

References
Archives and Collections


Humanities in Society 5: 279-295.


