Northumbria Research Link

A practice-led inquiry into the nature of digital jewellery

Craft explorations and dialogical engagement with people

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Abstract

In the widely explored area of wearable technology research, the theoretical work on digital jewellery has been largely done outside the art and craft context. Taking a jewellery perspective, this research focus on atypical personal interactions with digital technology in order to address questions associated with digital devices and potentially open up our expectations of the digital as a material within jewellery practice. Principally this thesis investigates he question "How can we design digital jewellery that are highly experiential and personally meaningful to the wearer?"

This thesis addresses the need for jewellers to assert their relevance in the current debates around digital culture and the meaning associated with wearing digital devices. This practice-led research project investigates the role of digital jewellery to support self in transition in order to progress these debates. For this research, I created research methods to support participatory engagements. Following the values of experience-centred design, I designed exemplars of digital jewellery. *Microcosmos, Topoi, Travelling with the Sea* and *Togetherness: Anthos and Chronos Brooches* are examples of digital jewellery that have resulted from this research. These concepts were inspired by the lives of three participants and myself who frequently travel back to our native countries but who live permanently in the UK and who experience feelings of being in-between.

Within the participatory engagements, novel design methods have been created for this particular research context. The method of Staged Atmosphere introduces the performative aspects of design probes in the context of a plane and the method of Dialogical Sketching offers a sensitive way to explore aspects of self in non-descriptive and imaginative ways with participants. These methods practised in this research contribute to design by enriching the role of creative practice to offer highly dialogical and sensitive to the research methodologies. My approach to designing digital jewellery has resulted in the development of a framework for understanding and conceptualising digital jewellery. The framework discusses the poetic qualities of the jewellery pieces by unfolding the narratives associated with their form, function and interaction. The framework contributes to discussions around how jewellery practices and digital technologies can suggest experientially rich interactions for people.

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Acknowledgments

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I declare that the work contained in this thesis has not been submitted for any other award and that it is all my own work. I also confirm that this work fully acknowledges opinions, ideas and contributions of the work of others.

Any ethical clearance for the research presented in this thesis has been approved. Approval has been sought and granted by the University Ethics Committee on June 20th 2016.

I declare that the Word Count of this thesis is 77749.

Glossary

Digital Jewellery: Digital jewellery refers to jewellry pieces with embedded electronic components (Kettley, 2008; Wallace, 2007). Similar terms are in use by practitioners across disciplines, such as smart jewellery, computational jewellery, tech jewellery and the interpretation of the terms may vary from one discipline to the other. I have chosen the term digital jewellery, not as a limitation, but as a starting point of the discussion around the potential role of digital worn objects in our lives.

Wearables: Throughout this thesis I use the terms 'wearables' and 'wearable technology' and "wearable devices' interchangeably, following Ryan's (2014) definition of wearables in terms of display and functionality: "Wearables are products worn by subjects whom intelligent systems sense and manipulate. Wearables find application in military research, health-care research, fashion and performance".

Micro-transitions: A micro level transition is concerned with experiences, negotiations and meanings in a personal setting (Holdsworth and Morgan, 2005).

Short-term micro-transitions: I use the term "short-term micro-transitions" to refer to the more everyday encounters that can cause nuanced unsettling to what one perceives, personally, to be a stable sense of life and of self.

Being in-between: I use the term "being in-between" to describe a period of time when one's sense of self is floating, shifting and adjusting to the changes during a micro-transition.

Sense of self: By "sense of self" I mean the unique attributes that distinguish us from others, attributes that bring different parts of our existence together by persisting through changes or opening ways to become who we want to be (Smith, 1978). The self is dialogic, a relation (Holquist, 2003) in reference to Bakhtin's philosophical work). Self is understood through its emergence and transcendence within a societal and cultural setting (Goffman, 1990) where people create narratives to make sense of themselves, plan their lives and shape their behaviour (Giddens, 1991, McLean et al., 2007, Taylor, 1989).

Dialogue: I follow McCarthy and Wright's (2015) understanding of dialogue as being a mutually responsive relationship rooted in trust and empathetic engagement with the other. Dialogue focuses on the processes between the people involved (rather than, in some cases, what each has to say).

1 Introduction

The widespread development of technological components that could be miniaturised and worn on the body has opened new possibilities for jewellers to explore the intersection of jewellery practices and the capabilities of digital technologies. Increasingly, jewellery can play a role in valuing the body; understanding, amplifying and highlighting the body. However, this area remains under-explored within contemporary jewellery practice. Additionally, research that focuses on personal, meaningful digital objects is limited and often not undertaken within jewellery practice. More specifically, jewellers seem to lack an understanding of the potential of digital as a material in their existing practices and technologists seem to lack the knowledge of the history and role of jewellery in peoples' lives.

Jewellery pieces hold meaning in our social relationship that often remain obsolete within wearable technology. The functions of jewellery pieces are often rooted in rituals and ceremonial activities, personal values, adornment, the supernatural power of jewellery to connect people with others in different spaces and time and the close relationship between jewellery and body (Besten, 2011, Cheung, 2006, Dormer and Turner, 1994). Therefore, most of the existing examples of wearable technology offer a limited interpretation of what digital jewellery could be by limiting the integration of digital technologies and jewellery to its existing place on the body, the aesthetics of the archetypes of jewellery and its use as a case for digital components (Wallace and Dearden, 2005, Versteeg and Kint, 2017, Koulidou, 2018). Either for sports, medical purposes or high-tech special effects in the catwalk, the body is often understood as being data that can be tracked and manipulated.

Jewellers can contribute more to the conversation of what it means for humans to be wearing these devices through raising their concerns via issues of privacy and intimacy. Such concerns are more *"fundamental to the practice of making jewellery rather than the practice of fashion or product design"* (Busch, 2015 p.56). Gaspar (2013) highlights that jewellers have a deep understanding of how

personal objects "vehiculate" and materialise identity and [jewellers have the expertise] in creating and transmitting value; they gain an awareness of the political, societal and cultural implications of their designs. Therefore, if we are to assert the relevance of our discipline within our current culture and the future of our field, we need to engage with the challenges of these questions:

How can the digital help us understand the self?

What is the value of a new way of imaging the body through the digital?

Can we as jewellers add value to this process?

Internationally, a small number of researchers have addressed similar concerns, showing a great interest in exploring how the combination of jewellery and wearable and digital technology could engender interactions with emotional significance for the wearer that go beyond the *mainstream* and *ordinary*. In their explorations, *the digital* becomes another material to incorporate into their practice and not the ultimate goal. Even though research in digital jewellery from this perspective is not new (Fusakul, 2002, Kettley, 2008, Versteeg and Kint, 2017, Vones, 2015, Wallace and Dearden, 2005, White and Steel, 2007), it is still very limited and does not have clear boundaries.

This thesis is my journey of making digital jewellery and understanding the rich conceptual space that is being opened up when we consider digital as a material within jewellery practice. Through creative practice, I seek to explore the more poetic interactions with digital jewellery that can enrich intimacy with other people, places and ultimately the self during period of transitions. Throughout the thesis, digital jewellery refers to jewellery pieces with embedded electronic components. Similar terms are in use by practitioners across various disciplines, such as smart jewellery, computational jewellery, tech jewellery and the interpretation of the terms may vary from one subject to the other. I have chosen the term digital jewellery, not as a limitation, but as a starting point of a discussion around the intersection of jewellery with digital and wearable technology. A discussion of the digital as a means of digital production and fabrication falls outside the scope of this thesis.

There are four audiences which I believe can benefit from different parts of this research. I believe that jewelers, design researchers, performance artists and anthropologists/cultural geographers could all benefit from the knowledge present within this thesis.

- Jewellers can learn about digital jewellery and ways to incorporate digital technology into their practice in conceptual and practical level.

- Design researchers can also benefit from the methods applied in this work and the creative ways of engaging people in discussions around sense of self and personal meaning.

- The performative aspects of the work can be useful for practitioners in the field of Performance Art.

- Audiences in Anthropology or Cultural Geography, who are interested in the theme of transitions to sense of self in various contexts can benefit from reading this study.

1.1 My Journey

I would like to give a brief overview of my background and my thoughts about jewellery to help the reader view the position I take in writing this thesis. I was born and raised in Thessaloniki (Greece) where I studied a full degree in architecture at Aristotle University of Thessaloniki. Following my academic studies, however, I decided on studying silversmithing and to follow my passion of making jewellery. I applied my design skills to making jewellery, where the forms were inspired by architectural forms and compositions. From a purely technical point of view, I was able to make good pieces of jewellery, but for me these pieces lacked a personal and meaningful focus. I realised that I did not know at the time what jewellery should be, or what it could be. Asking myself what the nature of jewellery actually is, I started reading books and publications on contemporary art jewellery. Meanwhile, the advances in digital technologies and fabrications had started dominating the field of architecture and design, whereas within the field of contemporary jewellery few craft practitioners applied such concepts.

In 2012, I decided to go to Denmark and study at the SPIRE Research Lab for an MSc in Information Technology and Product Design (ITPD). I was looking to explore jewellery practice while always bearing in mind the technological advances. The methods of working and teaching at the university were informed by

participatory methods in Scandinavia and cross-disciplinary research, which brought together engineers, interaction designers, design anthropologists and designers to tackle societal and technological issues. Although my role as a designer became less clear, I wanted to explore more participatory methods of working. As a result, I was able to adopt new approaches to working which were rooted in these participatory design methods. These approaches and experiences have influenced my methods of working to this day, for which I am very grateful. As a result, I have changed the emphasis of my research by becoming more interested in the role that digital jewellery has within people's lives. I encountered Jayne Wallace's work on digital jewellery and sense of self which was inspirational and was the reason why I moved to the UK for my doctoral studies.

It is important to mention that I explore the field of digital jewellery from a jeweller's perspective via looking at ways that it could represent highly emotional and personal meaning for people. To this end, this thesis combines my love for jewellery and my interest and curiosity in understanding the potential of digital technology in people's lives in different contexts.

1.2 The phenomenon of being in-between

In order to sit with this research, I think it is helpful to introduce the term "Being in-between" in the beginning of this thesis.

In this research, I focus on people in transition. Transitions in this context are the changes one experiences in physical, personal and social dimensions in the context of living in/between two countries and specifically when travelling between these two places, lives and senses of self (see more about the context in Section 2.6, p.44). The term transition has its origin in the mid-16th century from the Latin word transire meaning "go across". To avoid a confusion between *change* and *transition*, *change* is the result of a transitional experience, *"make or become different"* (Oxford English Dictionary), whereas transition is *"the process, a period of changing from one state to another"* (Oxford English Dictionary).

What it means to be someone who is from Europe and travels to the UK has changed radically with the American elections and the unsettling situation of Brexit. For many of us there is a very different dynamic of going home. It is not

just the ubiquitous feeling of moving from one place to the other (no matter where that place is) and connecting through changing languages. All these complex dynamics with living in different countries question more profoundly what it means to a sense of identity, a connection to a place and a sense of home. As someone who was born in Greece but who has lived and studied in a number of different countries, I have become acutely aware of the shifts to my sense of self that occur during the journeying to and from Greece and the country where I happen to be living. There has been something significant and noticeable about the reflections that I had during these journeys that highlighted this as being a period of time and particular context during which the shift between what my identity is in each country is more obvious to me and more pronounced.

> *"While I am sitting on the plane, waiting for departure, I realised that a lot of people on the plane were speaking in greek. In that moment I felt I was already at home, but I felt uncomfortable. Home, I thought it was not just the place, but my culture, my native language, the way people speak to each other. I needed time. Time to slowly get closer to home."* Personal Reflections during the flights from STN to SKG on the 8th of May 2015

I do vividly remember how I found myself feeling, thinking, and being at that moment. Thinking about these realities to life and if/how and where jewellery can contribute to enabling personal strength seemed really valuable to me and become the focal point of my research.

Throughout this doctoral study, I studied this phenomenon from my own experience and the experience of others, and I termed *being in-between* to describe the feelings and experiences associated with the changes to sense of self when travelling between two homes and the dynamic of these transitions. In order to better understand what it means and feels to *be in-between* I spent time observing my own lived experience of travelling through autoethnographic practices in order to get a sense how the phenomenon manifest itself before I start exploring it in dialogue with others. Within the participatory engagements, I used the term "self in transition" and "people in transition" to coin a similar situation. To situate this piece of work in the broader context of transitions I coined the term short-term micro transitions (see Section 2.6.3 p.47).

More broadly, I drew on a phenomenological understanding of our experience in the world, in which our bodies, our surroundings, our sense of self are constantly becoming, living and moving through the world. Such an approach involves a deep and sincere commitment to the inquiry, as a phenomenological philosopher Robert Sokolowski (2000) coins *looking at what we usually look through*. It means to try

to be profoundly present in our living, to slow down in order to open up to dwell with our surroundings; to remain open.

More specifically, I drew the attention to the specificities of the airplanes and airports as places with certain atmospheres that people experience during the physical transition. Airports and planes are liminal spaces (Andrews and Roberts, 2012) that we pass through as part of the physical transition one undertakes when travelling from one country/place to another. Such places have a certain atmosphere that we can only fully experience by "being there" (Oulasvirta et al., 2003). I will turn to this point later in the thesis where I discuss the notion of atmosphere and the value of working in-situ from a methodological point of view (see p.71).

1.3 Aims and Objectives

The overarching question for this research is:

How can we design digital jewellery that could support sense of self during short-term micro transitions?

Sub-questions:

- What are the qualities of digital jewellery that can be conceived to support sense of self?

- Can we conceptualise digital as a material within jewellery practices?

These questions were broken down into several aims that consist of:

Aim 1: Gain an understanding of contemporary conceptions of digital jewellery.

- The objectives to achieve this were:

- To conduct a contextual review of digital jewellery.

- To conduct a contextual review of contemporary jewellery.

- To conduct a contextual review of wearable technology.

- To create critical reflections on all three.

Aim 2: To gain an understanding of micro-transitions and sense of self.

The objectives to achieve this were:

- To conduct a contextual review of transitional experiences and how they affect sense of self.

- To position this research and specific methodology in relation to micro-transitions, sense of self and digital jewellery.

Aim 3: To develop a body of work that investigates digital jewellery in the context of micro-transitions and sense of self.

The objectives to achieve this were:

- To make examples of digital jewellery using craft practice that support my lived experience.

- To work with people who share similar life contexts and make pieces of digital jewellery inspired by their experiences.

- To develop a series of insights and understanding based on the reflections of this.

- To discuss the pieces with a group of experts in digital jewellery.

Aim 4: To develop methods of participatory engagement that are attuned to micro-transitions and sense of self.

The objectives to achieve this were:

- Create atypical immersive participatory environments.

- Develop creative methods for dialogical engagement.

The key contributions of the thesis can be summarised as follows:

- Situating digital jewellery within contemporary art jewellery practice and digital as new material for jewellers that expand the social potential of jewellery to connect us with other people, places and ourselves in new ways.

- Broadening the field of digital jewellery through presenting new

examples of digital jewellery.

- Developing a new framework for understanding and conceptualising digital jewellery.

- Widening the probe approach and contributing to creative ways for engaging participants in conversations around their sense of self.

- Identifying the context of airplanes as a space for the design of digital jewellery attuned to the changes to sense of self in the context of travelling between two "home" locations.

1.4 Thesis Structure

Throughout the three years of this PhD research, I have worked in an explorative way to unfold different aspects of the research question. In Chapter 2, I begin with a critically contextual review on digital jewellery (Part One) and I situate the research in the context of short-term micro-transitions (Part Two). In Chapter 3, I introduce my methodological approach in making digital jewellery and working with people. The question of how my creative practice-based research can and should be disseminated, communicated or published has increasingly drawn my attention. However, working towards this thesis' research contribution, I have chosen to leave this aspect of the work for a discourse of disseminating practice-based research.

In Chapter 4 I give a detailed description on the series of design iterations I developed to investigate the above questions. I have chosen to present the making activities (including the participatory engagements) in one chapter rather than as separate chapters in order to emphasise that each exploration is not a stand-alone piece of work, rather an iteration of my practice in my journey of making digital jewellery. Chapter 5 summarises the insights I have gained from the research in the context of transitions, the idea of home, digital jewellery and sense of self (Part One). In this chapter I include the insights gained from the methods (Staged Atmosphere and Dialogical Sketching) developed within the research (Part Two).

By comparing the overall body of work in relation to existing literature in digital jewellery and the insights gained from a group of experts in digital

jewellery, I connect the threads into a discursive chapter (Chapter 6) and I devise applicable design sensitivities for other practitioners and researchers in digital jewellery with a focus on the narratives of form and function and the qualities of the interaction (Part One). This chapter also offers a discussion on how the methods developed during this body of work contributes to design research methodologies (Part Two). To conclude, I summarise the contributions and share my thoughts on future work (Chapter 7).

1.5 Publications and Research Activities

Throughout the course of this PhD, some of this project work has been published in the form of conference papers (see list of publications p.9), exhibited during conference venues and shared with other academic institutions through talks and workshops.

The work presented in this thesis has been published in a range of formats. I will here focus on my individual contribution as well as the publications that were written in collaboration with my supervisors which have undoubtedly shaped the development of this research. Alongside the written work, I have given presentations about the work in conference venues and higher academic institutions. In this section, I also include other research activities that were undertaken during the course of this PhD research, which have shaped my thinking on the potentials of digital connectivity in various contexts.

Conference Papers (see Appendix D)

Koulidou, N., Wallace, J. and Dylan, T. (2019) *The materiality of digital jewellery from a jeweller's perspective.* In: Proceedings of the 4rd Biennial Research Through Design Conference, 19-22 March 2019, Delft, Rotterdam, Netherlands.

Koulidou, N. & Wallace, J. 2017. *Staged Atmosphere: The Air[craft] Workshop.* In: Proceedings of the 3rd Biennial Research Through Design Conference, 22-24 March 2017, Edinburgh, UK, Article 24, pp. 372-388. DOI: 10.6084/m9.figshare.4747003

Workshop Position Papers

Koulidou N. 2017. *Drawing[s] on experiences of self in transition: A visual dialogue.* Extended Abstract for Workshop SketchingDIS: Hand-drawn Sketching in HCI workshop at Designing Interactive Systems Conference (DIS '17). ACM, Scotland, United Kingdom.

Journal Papers

Koulidou, N. Wallace, J. Smith N. 2018 *The self between two places, finding connections through digital jewellery*. in Making Futures.Vol. 5. ISSN 2042-1664

Koulidou, N. 2018.*Why should jewellers care about the digital?* In Journal of Jewellery Research. Vol1.

Wallace,J.,Rogers,J.,Foster,J.,Kingsley,S.,Koulidou,N.,Shorter,E.,Shorter,M., Trotman,N.,2017. *Scribing as Seen from the Inside:The Ethos of the Studio.* Design Issues, 33(3), pp.93-103.

Presentations

PhD By Design conference 2015. Title of the presentation: *"Magazines: A reflective and dialogical tool for documenting design research"*. Department of Design at Goldsmiths, University of London in November 2015.

PhD By Design conference 2017 Title of the presentation: *"The self in practice-based research: Exploring the role of sketching in capturing experiences of the now"*. Department of Architecture. University of Sheffield. April 2017

NORDES PhD Summer School on Theatre in Design, University of Southern Denmark. Kolding, Denmark 22nd -26th August 2016

Talks and Workshops

I gave a talk about Digital Jewellery with the title: *What is Digital Jewellery?* National Institute of Design (NID), Ahmedabad, India. 2019.

I gave a masterclass on digital jewellery in Lucerne University of applied Sciences and Arts between the 2nd and 6th October 2018

I gave a talk about Digital Jewellery with the title: *Data that matter[s] to us* School of Design, Edinburgh College of Art. 2017

I gave a talk about Digital Jewellery with the title: *What is Digital Jewellery?* School of Design, Northumbria University. 2016.

Exhibitions

Research Through Design (RTD) Conference. 2019. Delft and Rotterdam, NL, between the 19th and 22nd of March 2019.

Research Through Design (RTD) Conference. 2017. Edinburgh College of Art, between the 21st and 24th of March 2019.

Making Futures V September 2017. Mount Edgecumbe. Plymouth, between the 21st and 22nd of September 2017.

Other research activities

I participated in the *Connected High Street Project*. EPSRC Research in the Wild Internet of Things Project. 2015. I documented the research outcomes in visual documents in the form of magazines.

I participated in one-week workshop *"Connected Home",* Berlin Design Sprint, Mozilla Festival, Berlin, between the 22nd – 25th of April 2016.

I participated in the two days Great North Museum Design Challenge Workshop *"Remake a Museum Design Museum Challenge",* Hancock Museum, Newcastle upon Tyne between the 3rd and the 4th of December 2016.

I participated in the one-day workshop *"Social Wellbeing and Drinking Culture: Exploring Digital Futures"* organised by Shaun Lawson and NorSC- on the 20th of September 2017.

I participated in a PhD Summer School on Theatre in Design, University of Southern Denmark. Kolding, Denmark between the 22nd and 26th August 2016.

2 Contextual review
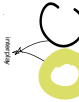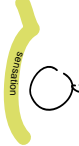
This chapter is divided into two parts. Part One covers my contextual review on digital jewellery, contemporary art jewellery and critical review on current conceptions of wearable technology and Part Two situates my study within the context of micro-transitions. More specifically:

In Part One, I present a contextual review of digital jewellery as part of wearable technology and I will offer a critical review on current conceptions of digital jewellery. I position myself within the current discussion in the field of contemporary art jewellery and I explore digital jewellery from contemporary jewellery point of view to reveal a rich conceptual space for makers when they are designing digital jewellery. Before I describe each section, I offer an overview of ways of understanding digital jewellery in the Table 1.5-A (on page 13).

In Part Two, I present the context that informed my thinking when designing digital jewellery. As already asserted (see Section 1.3), in this study, I have sought to make pieces of digital jewellery that could support a sense of self and I have primarily drawn on my own lived experience in this investigation – moving on to work with participants. In this section, I fully situated this context (micro-transitions) and why it is pertinent and useful as a backdrop for the development of digital jewellery.

Table 1.5-A Mapping the terrain. Existing conceptions of digital jewellery.

digital jewellery - what do we know?

Digital Jewellery as Gadgets	Flex 2 Fitbit accessories (to encase Fitbit Flex tracker).	embed
Digital Jewellery Visualising Emotions	Fight-Fight (left), Under my Skin(middle), Skin&Bones (right), Ugur & Duncker, 2013	change
Digital Jewellery in Healthcare	Diabetes Necklace and Ring (Heiss L. et al., 2008-09)	interplay
Digital Jewellery and Personal Memories	Lens (White H. et al.,2008)	support /enrich
Digital Jewellery and Digital Qualities	Blossom (left) (Wallace J., 2004), Lockets(right) (Wallace & Thomas, 2011)	question
Digital Jewellery and Digital Sensation	Swarms (left) (White H. et al.,2008), Light Projections (right) (Pangaratetor, 2014)	sensation
Digital Jewellery and LiveData	Vanity Ring (left) (Keon M., 2007), Address (right) (Andriaos M., 2009)	screen
Digital Jewellery and Digital Tools	Brooches (left) (Hath A.,2011), Radiolaria (right) (Nervous System, 2012)	

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Part *One*

2.1 Digital Jewellery as Part of Wearable Technology

In the beginning of the digital age jewellery gained interest as objects already worn on the body. The digital information conveyed in rings, bracelets, necklaces, and wristbands is a generation of devices worn on the body, widely known as wearable technology (Ryan, 2014). Even though wearable technology has been around for decades, it gained acceptance when it was introduced as aesthetic appealing jewellery objects and then as functional devices (Miner et al., 2001). The term 'digital jewellery' was first introduced as wearable technology for everyday use when traditional forms of adornment are involved with wearable and digital technologies (ibid).

One early example of digital jewellery is the IBM set; a digital jewellery prototype of a cell phone that consists of several jewellery pieces that work together wirelessly. Speakers embedded into earrings will be the phone's receiver, a necklace with an embedded microphone, a "magic decoder ring" will be equipped with LED to indicate an incoming call and a bracelet will be equipped with a video graphics array (VGA) display which could be used as a caller identifier that flashes the name and the phone number of the caller. The main intention of IBM's Almaden designLab was to make technology part of our daily life with the help of jewellery pieces connected with wireless networking system.

> *Worn throughout the day, digital jewellery could connect the user anytime, anywhere to information, business, and communication services. Within its known placement on the body, jewellery forms can be used as an intuitive interface [...] The technologies have been placed in appropriate places in the jewellery and on the body: a speaker by the ear in an earring or earpiece, microphone by the mouth in a necklace or pin, display in glasses, watch, or bracelet, input and control at your fingertips in a TrackPoint ring. (Cameron Miner, 2001 p45-46)*

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Figure 2.1-1 Digital Jewellery Set by IBM's Almaden designLab,
1993. Visual prototype.

Source: Miner, 2001. P.45

Concurrently, Picard (1997) at MIT Media Lab focused on sensing the wearer's autonomic bio systems. She indicated how jewellery, being relatively instructive in our daily lives, can effectively gather information about our habits and reactions to stimuli (Picard and Picard, 1997). In the more recent Human-Computer Interaction (HCI) literature, digital jewellery is defined in similar terms as being "fashion jewellery that allow you to communicate by ways of e-mail, voicemail, and voice communication" or "wearable ID devices that contain personal information like passwords, identification, and account information" (Jain, 2015). Activity monitors for fitness purposes provide the wearers with detailed information on their everyday practices; counting steps, measuring heartbeat and recording bio sensory data in real time. Since the first digital jewellery to embed functions of digital devices in existing worn objects, jewellery continues to gain interest with more recent examples presented as luxurious smart accessories. Companies such as Nike, Fitbit or Jawbone collaborated with jewellery designers, for example, Tory Bunch for Fitbit and Yves Behar for Jawbone UP3 Wristbands in order to produce luxurious cases for the fitness trackers (see Figure 2.1-2). However, such examples fall into the category of gadgets (Wallace and Dearden, 2005) or jewellery-like devices (Silina and Haddadi, 2015).

Figure 2.1-2 (left) Flex 2 Fitbit accessories (to encase Fitbit Flex tracker). (right) A picture of an iOS phone with the Fitbit application. Silver, electronic components.

Source: Press Kit. Image courtesy of Fitbit.

2.2 Digital Jewellery as Part of Wearable Health Devices

There is a long history of medical devices being worn on the body, however they were scarcely considered as being pieces of jewellery. Rather, they were seen as devices that stigmatize the wearer and affect their sense of self in a negative way. With the miniaturisation of the electronic components and the advances in digital technology, sensors have become tiny and affordable and new ways of fabrication has started the conversation on how these devices can be made into beautiful objects. In the recent years, some examples of medical devices are presented as pieces of digital jewellery that people would like to wear and cherish. Examples from the research field the Diabetes Necklace (Heiss), Smart Heart (Heiss et al., 2016) (see Figure 2.2-1) or the pre-order product Olive Next-Gen present a range of discreet and beautifully designed housings for therapeutics. These examples of wearable health devices start with the intended function. From a

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social perspective, such objects have the potential to make people feel better about themselves and their condition, and this is really valuable aspect of these objects. However, the synthesis of jewellery and digital technologies is often limited to the requirements imposed by the health condition and often, jewellery, in this context, serves as "a nice box" to host the technological equipment. Moreover, the functionality of a wearable health device limits the form of the piece and its relationship with the body.

Figure 2.2-1 *Smart Heart cardiac monitor necklace* by Leah Heiss, 2016 in collaboration with St. Vincent's Hospital Melbourne, RMIT University, and the Nossal Institute for Global Health; 3d printed parts, conductive threads, sensors.

2.3 Digital Jewellery: Visualising Emotions

The expressions of the body are at the core of many research projects in the field of fashion. Computationally controlled garments and accessories detect changes of temperatures, moisture and transmit messages in the form of light, visual graphics and movement making visible bodily states.

Visualising Emotions is a widely explored theme in the field of wearables, however often the research draws on the understanding of emotion from such diverse areas as psychology, neurology, medicine and sociology. Neurologists, for example, have studied that emotions are processes going from frontal lobe processing in the brain, via brain stem to body and back (Damasio, 2006). In many

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wearable devices, the sensing of bodily movements or bio-data are often tightly coupled with the emotion processes in this simplified way. Vein 2 (Fusakul, 2002) and Skin-Bone (Uğur et al., 2011) (see Figure 2.3-1) are examples of digital jewellery that detect changes on emotional status of the wearer and respond with movement (Skin-Bone) and light (Vein2). Vein2 changes colour as the wearer's heartbeat increases and Skin-Bone interprets the wearer's inner state through the movement of the prototype. When the wearer reaches a certain stress level, the necklace starts moving up to the neck. By pulling the necklace down, the wearer can be aware of her/his emotional state. Both Fusakul and Uğur have created objects that display emotional changes in the wearer. However, Ugur's object also displays emotions in a social and discursive way in order to better understand the limitations of this type of interactive object. *But to what extend and in which setting do we want to visualise our emotions?*
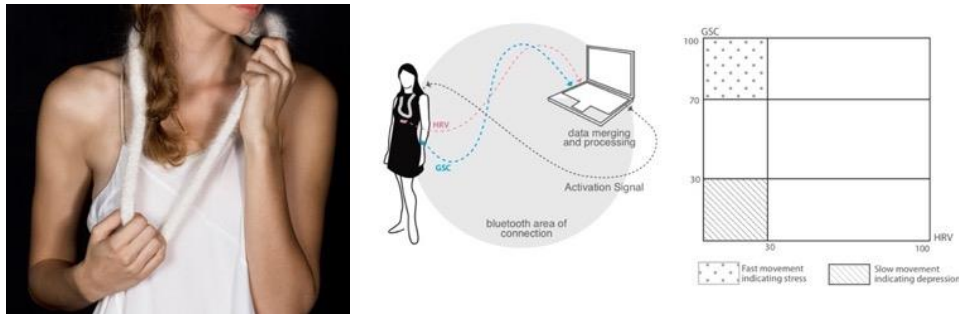
Figure 2.3-1 (left) *Skin-Bone* by Sesil Ugur, 2011. Soft material, sensors, electrical motor wireless network. Photographer Masha Ru.

(right) Detail on how the *Skin-Bone* prototype works. Code patterns for stress levels.

Seçil Uğur Yavuz © 2013 all rights reserved. Image courtesy of the artist.

2.4 Critical reflections on the body and wearable systems

In the field of wearable technology, today there exists an increasing number of devices considered intimately linked to the body; Internet of Things (IoT), e-textiles and bionics. While most of these devices are already commercially available (such as smartwatches and fitness trackers), other nuanced products including colour-changing textiles or bionic-prosthetic devices serve more

specialised fields such as fashion or medicine. Many such devices are used to track body fitness, manage phone calls and organise messages or notifications from social-media. As communication devices, they have some of the functionalities of a mobile phone; they receive calls, send reminders and notifications. As objects worn on the human body, they are small in size and typically have limited functionality, with minimal interfaces, compact displays and lower computing power. These examples of wearables, otherwise described as gadget (Wallace, 2007) are often connected to faster computing devices. They are often supported by an application that can be accessed via an Android or iOS phone, while the device works in the background. Wearable and the network of devices to augment people's everyday lives have become part of the consumer electronic landscapes, however some interesting questions arise regarding the quest for monitoring and measuring elements of one's body, behaviour and habits.

In other research, computationally controlled garments and accessories detect changes of temperatures, moisture and transmit messages in the form of light, visual graphics, or movement. Here, wearable technology functions a spectacle, contending with the trend towards high-tech special effects in the catwalk where the body becomes the object of artistic experimentation (Ryan, 2014).

From a ubiquitous connectivity perspective, wearing communication, putting it on our bodies, sensing our bodily movement and connecting with real-time data has been changing the way we experience our bodies and ourselves. Hundreds of apps have been developed for achieving digitalised self-tracking and Wolf and Kelly (2007) list over 500 self-tracking tools including geolocation, health, fitness, and weight, sleep, diet and mood or feeling tracking apps. The increased availability of wearable devices and tracking apps has led to the development of a large community of movements that present self-tracking as a promising way to promote wellbeing. Quantified Self (QS) (ibid.) is such an example associated with self-tracking and monitoring of any physical, behavioural or environmental information in order to monitor or instigate change.

Wearables in the market are following the logic of what De Landa (1991) refers to as technological determinism, where technological innovation is looking for the next, expected level of evolution. This reflects what Ryan (2014) refers to as *"a functionalist prejudice that technology is always in the present"* (p.5). A related hypothesis holds that making sense of numbers is equal to making sense of yourself, suggesting that quantifying the self and attempting self-knowledge through numbers is at the core of most wearable technology. Accumulating

numbers about our behaviours and our bodies for personal and commercial purposes makes us wonder *"How much do we want to monitor ourselves? How much information is too much?"* (Busch, 2015).

Several authors have called into question the aim of wearables to cure, correct and enhance the performance of the human body. Morozov (2014) more broadly describes the field as being *"madly devoted to articulating facts through numbers",* which generate narratives or *"numeric imaginations"* that *"seek out qualitative and linear casual explanations that have little respect of the complexity of the actual human world"* (p.260-1). This resembles Busch's (2015) critique of the narcissistic view of self-improvement and Hacking's (1982) critique of the *"fetishist collection of overt statistical data" and "the avalanche of printed numbers"* (p.28).

> *"It is hard to argue against the efficiency of all this self- improvement, but it is equally hard not to wonder at what point self - awareness evolves into narcissism."(Busch, 2015 p.53).*

The functions of the human body within the wearable technology era are observed analytically with a view of curing, correcting and enhancing performance. It often takes a diagnostic approach via sensing and displaying the wearers' emotions and assumes a view of the body as data (Ryan, 2014) and as something that can be controlled (Höök, 2013). Lupton (2016) has published extensively a critique on the quantified self, exposing the tension between control and empowerment that follow from the ongoing collection, aggregation, representation, flow and re-contextualisation of personal data for commercial and political purposes. Similarly, Ryan (2014) highlights that activity monitors are *always on*, providing the wearers with detailed information on their everyday practices; counting steps, measuring heartbeat and recording bio sensory data in real time. The wearer often is represented *"as a regulated or mediated subject"* (p.99).

However, we have messier and experiential forms of living that are not mapped from the data which is extracted from such devices. In an attempt to identify the limitations of an aspect of wellness that is driven from data streams, O'Riordan (2017) compares the use of letter writing and journals among middle-class women of empire in the nineteenth century with the journal functionality in the Fitbit dashboard. She outlines that the use of Fitbit orientates users *"towards intensive mediated individualism and a treatment of life in terms of countable units"* (p.60), whereas Dorothy Wordsworth's journal entries for January 1798 is an example of

data extracted from a much more open and relational aspect of a sense of self.

> *21st. Walked on the hill-tops - a warm day. ...*

> *22nd. Walked through the wood to Holford. ...*

> *23rd. Bright sunshine, went out at 3 o'clock. ...*

> *24th. Walked between half-past three and half-past five. ...*

> *25th. Went to Poole's after tea...*

> *(Exerts from Dorothy Wordsworth's journal entries for January 1798 as extracted from O'Riordan 2017 p.56)*

Arguably, current conceptions and examples of wearable technology relies on technological solutions that focus on functionality and efficiency and the body is often treated as data that can be measured and controlled. To move away from the praise of a *"corporate wellness" through self-qualification and "a circuit of self, device, work, gym, eat and sleep (repeat)"* (O'Riordan, 2017), new approaches to designing wearable technology are necessary and critical. A deeper exploration of what it means for people to be wearing wearable devices requires an approach to wearable technology that goes beyond the interpretation of numbers to more relational aspects of wellness and sense of self.

2.5 Digital Jewellery as part of Contemporary Art Jewellery

"We associate jewellery objects easily to a person, real or imaged. Jewellery is not for something; it is for and of someone"

(Cheung, 2013)

"Jewellery becomes more than objects; They are connectors"

(Ahde-Deal, 2013)
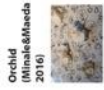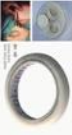
"Jewellery often functions as a symbol of self, as a signifier of aspects of identity, as a conduit to transport us to other times, places and people, and as a receptacle for our feelings of that associated other"

(Wallace, 2007)

Over the last two decades, the discussion around the significant role of digital worn objects and the experiential qualities of wearable technology has been opened up and new perspectives and methods from researchers have suggested alternative ways of integrating digital worn objects in peoples' lives. Artists and designers fascinated with technology have explored, not just "*what it is that we can do with technology, but what technology tells us about ourselves*" (Ryan, 2014 p.7). This is an era in which jewellers can contribute through having an understanding of what it means for humans to be wearing these devices (Busch, 2015, White and Steel, 2007). This discussion is about where digital jewellery finds its role and significance within the field of wearable technology.

In this section, I explore the context and implications of digital jewellery within contemporary art jewellery practice through selected pieces of jewellery (made by jewellery and in some cases product designers) through considering the object's materiality and the qualities of the interaction. In doing so, I reveal a rich conceptual design space. This critical review of digital jewellery defines a need for a better understanding of the digital experiences within contemporary art jewellery.

Table 2.5 A Examples of digital jewellery.

2.5.1 My position within Contemporary Art Jewellery

Here, I clarify my position in relation to contemporary jewellery and the discourse surrounding the field, by presenting examples from practitioners that inform my practice as a digital jeweller.

Jewellery is one of the oldest forms of body adornment and has frequently been held in high regard as a symbol of status and a way of augmenting beauty. Using a variety of materials ranging from bones to diamonds, jewellery has developed into a set of cultural and behavioural patterns that have barely changed in thousands of years (Goffman, 1990). Historically, jewellery is objects that express parts of who we are (Broadhead, 2009, Gaspar, 2013). The art historian Jorunn Veiteberg (2013) has underlined that jewellery still offers a language we can use to tell the world who we are, what we stand for and what we would like to become. As much as jewellery is about the self, it also exists in the dialogue between the self and others in a social context. It is a form of communication, a sign that can be often read and understood by others, demonstrating a continual two-way process of expressing something about a person, and the impression it makes upon others (Broadhead, 2005).

Either worn or not, hidden or visible, jewellery is objects that offer the potential to explore and construct identity and meaning (Broadhead, 2005, Rana, 2002). By wearing and possessing a piece of jewellery, people ascribe meaning and attach values to it. These values are often associated with a historic, ornamental, magical, symbolic or sentimental significance (Besten, 2011). Several studies have been carried out regarding the reasons why people wear and possess jewellery (Ahde-Deal, 2013, 2017, Goffman, 1990, Potter, 2007, Rana, 2014) and these have revealed both its emotional and personal value. The art historian Marjan Unger (2011) refers to the main function of jewellery as being that of connecting people with significant others who lived before us or are living with us. In the same way, jewellery has been characterised as being a physical representation of memories and as a provocateur of emotions which connects us to past experiences and relationships (Ahde-Deal, 2013).

Since the 1960s, the radical New Jewellery Movement, known also as *contemporary jewellery*, *studio jewellery*, or *author jewellery* (Besten, 2011), has changed our expectations of what jewellery can be and what it stands for. The conventional forms and materials were rejected in favour of more expressive and experimental forms. This experimental character was driven from an artistic

expression. Jewellery becomes a commentary on social, political, environmental issues and raises a broad variety of issues concerned with preciousness, identity, wearability and beauty.

Reflecting on the role of jewellery without including the body is hardly possible. It is made for the body, and therefore it invites the presence of the wearer even if only metaphorically. Placed within the intimate space of wearer's body, it gives a particular intimacy to the piece that is absent from other objects in arts and crafts. Wearing something close to the body offers the circumstances and the territory to explore issues of identity and declare relationships with others (Broadhead, 2005). A piece of contemporary jewellery can refer to an object which is simply held in the hand, an image stamped or projected onto the body, or a photograph as the final piece. It could also be ready-made, requiring little or no alteration in order to wear it. Arguably, this field has broadened its boundaries, however jewellery has put the relationship between the body and the piece in question.

The practice of contemporary jewellery has gone far beyond its traditional forms to sculptural shapes and the use of the most unconventional materials; pushing the relationship between the body and the piece of jewellery to the extreme. This has often been criticised for expanding the field to such an extent that jewellery could be anything as long as it is driven from an artistic expression (Adamson, 2013, Barthes, 2006). The jeweller and researcher Susan Cohn (2009) refers to the limitations of contemporary jewellery practice as being the potential of jewellery to constrain intricate social relationships. Likewise, Rosa Slivka wrote in 1983 "*...[This] jewellery does not accommodate the body. Jewellery is in orbit around the body, a galaxy of planets whirling on their dervishes*." (Barthes, 2006). The body as a site for jewellery raises a number of questions about the relationship between the wearer, the piece, and the maker.

Although contemporary jewellery has been criticised for keeping distance from the physicality of the human body, often being presented in galleries, there are examples that aim to provoke and stimulate emotional reactions and responses. Such pieces create the space for dialogue between the piece and the wearer, as well as the maker and the piece. This relationship opens a new way of thinking of the wearer as a person; we can imagine a piece on the body or relate to the piece in an emotional and personal way. Good examples of contemporary jewellery make people position themselves in a personal, societal and cultural context. Significantly, they leave space for the wearers to reflect on who they are, what they

stand for or what they want to be. From this perspective, the variation of materials and new techniques are tools for jewellers to create pieces that stimulate and provoke emotional responses. The narrative that accompanies the piece adds value to it.

I will now present examples from practitioners that inform my practice as a digital jeweller.

Figure 2.5-1 *Gold makes you blind* by Otto Künzli, 1980. Gold, rubber.

Source: (Hufnagl and Neue Sammlung, 2013), p.152

Gold makes you blind (1980) by Otto Künzli (see Figure 2.5-1), is an early example of contemporary jewellery practice which had a significant contribution to the field. Jewellery made of gold has widely been considered as being a status symbol. The piece is a bangle made of gold encased in black rubber. It raises questions on preciousness, asking the wearer to re-consider what is valuable in the piece itself and what is important to them personally as the wearer is the only one who knows it is gold beneath the rubber. The significance of the piece lies in its provocative character.

In other cases, the physical interaction with the body is the reference point. The *Sediment Necklace* (1995) by Ruudt Peters (see Figure 2.5-2) is a necklace with two layers (reference in Manheim, 2009). The black paint in the outside layer of the piece is gradually rubbed off as the piece come in contact with movement and body heat. In similar terms, the piece *Soap with a String of Pearls* (2002) by Manon van Kouswijk (see Figure 2.5-3) invites us to think of the interaction between the piece and the body alongside its significance. The piece is made of

soap and a pearl necklace. The soap gradually dissolves when washed and the pearl necklace slowly comes out the more the soap has been used up. These pieces made us feel and experience our body in a dynamic perspective.

Figure 2.5-2 left. *Sediment Necklace* by Ruudt Peters, 1995. Silver, black paint. Photo courtesy Chi ha Paura…?

Figure 2.5-3 right. *Soap with a String of Pearls* by Manon van Kouswijk, 2002. Freshwater, pearls, silk, glycerine soap. Photo courtesy of the artist.

Source: (Manheim, 2009), p.89

The early work of Susan Heron offers a completely different perspective of what a piece of jewellery can be. In *Light Projections* (1979), Heron explores the sensation of wearing light on her body. In a series of pictures, she captures herself "wearing" the projected lines (Heron, 1979). Similarly, *Game me* (2000) was an installation set up by Monika Brugger, where visitors were invited to explore their body and experience a similar physical sensation of wearing a necklace of light (Brugger et al., 2009). Jewellery can be a sensation; the body moves and the piece changes, leaving an impression of the moment.

Other examples of contemporary jewellery practice highlight the sentimental and unique value associated with jewellery. *Locked Lockets* (2005) by Lin Cheung is a series of pendants that visualise the intrinsic and personal character of jewellery (Cheung, 2013). One example is the piece *Breath/e* which reveals erotic words on the back of its surface with a single breath at close proximity. Another from this series is the piece *Secret* that keeps a secret permanently sealed. Since the Victorian era, lockets have been used to commemorate the memory of a beloved one or were given as a token of affection. Parts of the body, such as hair, or

photographs and paintings of lover's eyes were often inside the locket or hidden on the back side of the piece (Luthi, 1998). The symbolic shape of the locket in Cheung's work indicates its sentimental value and its intimate connection through bodies; parts of one's body are enclosed in the locket and are being worn on another body. The personal message in *Breath/e* remains hidden from the public and in *Secret* the message cannot be revealed at all. Her work opens a dialogue on personal values and relationships with the objects we possess and the meaning they hold.

Other examples have the power to connect us with parts of ourselves that are intimate and personal. Jewellers give glimpses of their lives and what is personally meaningful to them. The composition of materials with emotional significance and its relation to personal narratives is identical in the work of Iris Eisenberg. Her pieces have a great aesthetic appeal. The series *Heimat* (2004) (see Figure 2.5-4) and *New Rooms* (2008) (Figure 2.5-5) consist of brooches made in response to her sense of longing and home. Materials and composition respond to the familiar and recognisable home in *Heimat* and to the strange, distant and unknown in the *New Rooms*. Steel, glass, wood and cotton construct an architectural experience on a small scale. Her work makes us think of the familiarity of home and the strangeness of new environments, as well as the transitional period of not belonging.

Figure 2.5-4 *Heimat* by Iris Eisenberg, 2004. Silver, earth. 12x7x2cm

Figure 2.5-5 *New Rooms* by Iris Eisenberg, 2008. Wood, cotton, brass. 20x6x6xm

Source: (Mauerer Zilioli, 2016), p.132-137

Figure 2.5-6 *Memoria*, Editions, ear pieces by Lin Cheung 1999. 18 ct gold, silver.

Photo: Lin Cheung.

Source: Manheim, 2009 p.71

Memoria (1999) by Lin Cheung (see Figure 2.5-6), and *Seven out of Fifteen Rings* (2007) by Kate Maconie (see Figure 2.5-7) are examples of contemporary jewellery that are a response to the feeling of the loss of a beloved person. *Memoria* is a piece made in memory of Cheung's mother. Cheung discovered several butterfly scrolls in her mother's drawer that neither belonged to an earring nor had any meaning or use on their own. For *Seven out of Fifteen Rings*, Maconie made a cuttlefish casting of one of her late mother's rings which had a significance to her. A cuttlefish casting would usually only be used once, as subsequent castings would lose its details. The artist casted the ring over and over again, resulting in a set of 15 rings that gradually lost the details of the initial piece. Such pieces can be also read as being a physical manifestation of the process of grief.

Figure 2.5-7 *Seven out of Fifteen Rings* by Kate Maconie, 2007. Cast silver. Photo: Kate Maconie.

Source: Manheim, 2009 p.71

In similar way, in *Wedding Rings and Necklace* (2006), Mike Guy and Rebecca de Quin (see Figure 2.5-8) follow a destructive process to create a new piece of jewellery. They melt down golden objects inherited from their families in order to cast their own wedding rings. This process has a symbolic meaning; the flattening of memories held within the old pieces for the creation of a new piece while they are connected with their family through the material.

Figure 2.5-8 *Wedding Rings and Necklace* by Rebecca de Quin, 2006. Mixed gold items. Photo: Jim Cheatle.

Source: Manheim, 2009 p.19

The repetition butterfly scrolls in *Memoria* and the reproduction of the same ring fifteen times in *Seven out of Fifteen Rings* shows the intensity and the agony one goes through during loss, while allowing space for new pieces to be a way to go ahead and adjust to the change. Mike Guy and Rebecca de Quin use the transformation process to reflect on ways of connecting with their family by making a new object that signifies a new connection with their marriage.

In this personal dialogue is where, I believe, contemporary jewellery finds its place and its significance in people's lives. These are the types of contemporary jewellery that inform my practice as a digital jeweller to design pieces that could lead to rich experiences for people.

2.5.2 Digital Jewellery and Personal Memories

Pieces of digital jewellery can act as enablers to access visual and audio data, thus helping the wearer to connect with their own narratives. In addition, the materials support this connection between the wearer and the piece.

An example of this exploration is the piece *Lens* (2007) by Hazel White (see Figure 2.5-9). The piece is a pendant which looks and feels like a smooth piece of glass that has been washed up by the sea, and serves as a memento of the wearer's family holiday on the Isle of Skye. When the viewer holds the piece up to a mirror in his/her house, an image of skimming stones across the water appears against the landscape of Skye (White and Steel, 2007). *Lens* invites the wearer to experience an intriguing and site-specific interaction. It is intriguing because only a part of the picture is revealed from the pendant's reflection on the mirror, inviting the wearer to move the pendant and explore the landscape of the Isle of Skye only in glimpses. The interaction is site-specific because it can only happen in a specific location.
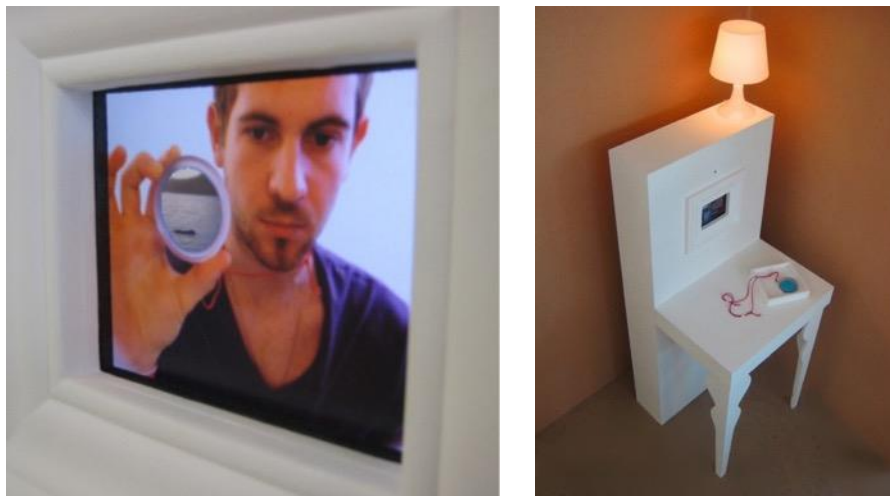
Figure 2.5-9 *Lens* by Hazel White 2008, left. Detail on the pendant's reflection in the mirror. Right. The installation. Glass, electronic components.

Another example is the piece *Purple Locket* (2015) (see Figure 2.5-10) by Purple Technologies, LLC. The piece is a concept prototype of a digital locket that stores digital pictures, which takes into consideration the long history of lockets to commemorate the memory of a beloved one to become a token of affection (Luthi, 2001). Similarly, digital pictures are hidden inside the digital locket. The piece does not have a USB charger; rather, it charges when it is placed in the accompanying box and the symbolic shape of the locket indicates its sentimental value and its intimate connection. However, the interaction with the piece relies heavily on familiar interaction with mobile phones.

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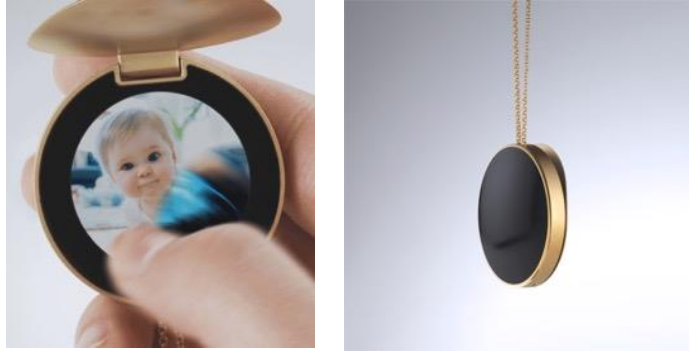
Figure 2.5-10 *Purple* by Purple Technologies, LLC 2014. Concept prototype of a digital locket.

In comparison, the digital lockets *Remember*, *Forget*, *Daguerre* and *Orpheus* (2010) by Jayne Wallace (see Figure 2.5-11) explore "different framings of what a digital locket implies by unpicking assumed qualities of digital technologies and considering alternatives" (Olivier and Wallace, 2009), thereby staying faithful to the historical use of the lockets. *What if we could take only one digital picture? And what if that picture slowly fades out?* The pieces suggest interactions with digital technology that are unique and intriguing by staying faithful to the historical use of the lockets.

Figure 2.5-11 *Remember, Forget, Daguerre and Orpheus* by Jayne Wallace 2010 in collaboration with James Thomas and Derek Anderson. Silver, electronic components.

2.5.3 Digital Jewellery and Intimate Connections in Real Time

A small number of jewellers explored ways of using digital technology to connect individuals over distances or in close proximity in an intimate and personal way. *For two rings* (1994) (see Figure 2.5-12) by Gratiot Stöber (reference in Wallace and Dearden, 2005) are two rings which can be physically activated in response to the physical interaction between people. Sensors detect when the two pieces are connected and light sources illuminate when the shapes are touched. The gesture of holding hands is amplified by the illumination of the pieces and the light fades gradually when the contact is broken. This project is an example of digital jewellery focused on the experiential qualities of human touch, where the body responds to the jewellery and the jewellery responds to the body. The piece has been criticised for its limited digital functionality (Silina and Haddadi, 2015).
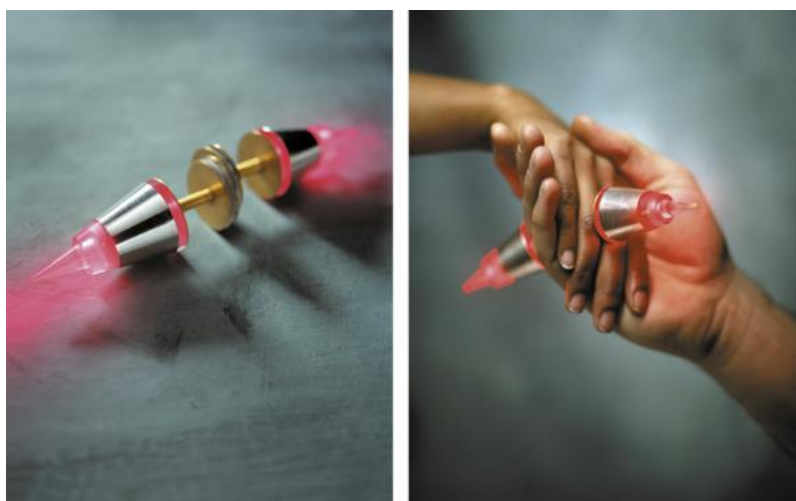
Figure 2.5-12 *For two rings*, Nicole Gratiot Stöber 1994. Magnets, stainless steel, perspex, LEDs with electronic components. Photographer Christoph Grünig

Nicole Gratiot Stöber © 2004 all rights reserved. Image courtesy of Daniel Gratiot.

Blossom (2007) by Jayne Wallace (see Figure 2.5-13) is a digital jewellery visual prototype that explores new ways of communication over distance between a grandmother and her grandchild.

> *"The piece is connected to a rain sensor, planted on the participant's family land in Cyprus. Inside the dome the old Cypriot postage stamps are closed like a flower, attached to a mechanism, waiting to receive a signal sent from the rain sensor. Once the rain sensor has registered a predetermined quantity of rain in Cyprus, which may take months or even years, a signal is sent to the jewellery object and the mechanism is*

activated, slowly opening the petals like a flower blossoming." (Olivier & Wallace 2009 p.212)

In addition to the emotional connection with a family member, the piece connects the wearer with an intimate place. The piece acts as a memory trigger for a particular place and a connection with another person at a particular time. The piece will be activated only once, thus introducing a unique and anticipated interaction.

Figure 2.5-13 *Blossom* by Jayne Wallace 2004. Wood, glass, silver, vintage postage stamps, printed images.

In comparison with IBM's set of digital jewellery prototypes, the pieces *For two rings* and *Blossom* are examples of digital jewellery that suggest interactions with significant others beyond the verbal and direct forms of communication and which question our expectation of the "digital" as that of being instant and repetitive.

Address (2007) (see Figure 2.5-14 below) by Mouna Andraos & Sonali Sridhar and *Vanity Ring* (2007) (see Figure 2.5-15) by Markus Kison are pieces of digital jewellery that connects the wearer with geographical and personal data. *Vanity Ring* does not have a jewel. Instead, it shows the number of "hits" one gets when one searches Google for the name of the person who wears it and displays it. The ring is personalised and updated overnight. In its essence, the piece is provocative and raises issues of identity. *What is the value we attribute to our online identity?*

Address is an electronic necklace with an embedded GPS which calculates the distance between the wearer's place and an intimate place, chosen by the wearer.

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The use of data in the piece *Address* differs from *Vanity Ring* as it updates constantly. A small display on the necklace measures the distance in kilometres. The piece is not indicating how to reach a place, as normal GPS technologies would do, rather, it communicates a bond with a space. The piece has a poetic quality to connect with a place in an experiential way, thereby suggesting an interaction that is imaginative and intriguing.
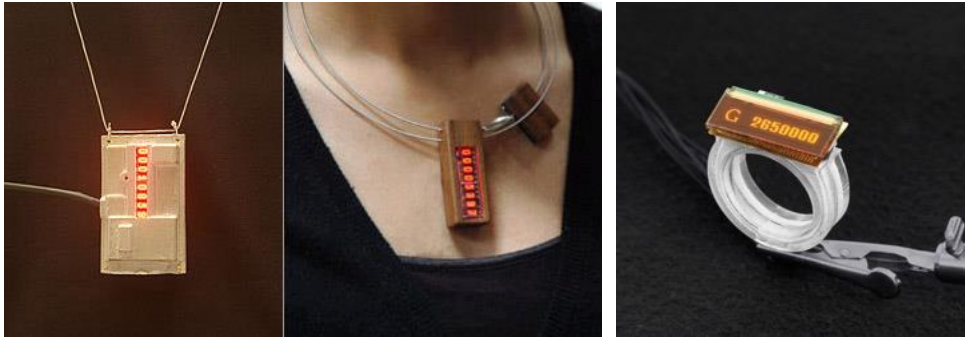
Figure 2.5-14 left. *Address by* Mouna Andraos and Sonali Sridhar 2007. Electronic components, wood.

Mouna Andraos and Sonali Sridhar © 2007 all rights reserved. Image courtesy of Sonali Sridhar.

Figure 2.5-15 right. *Vanity Ring* by Markus Kison 2007. Electronic components, plexiglass.

Markus Kison © 2007 all rights reserved. Image courtesy of the artist

2.5.4 Digital Jewellery and Bodily Awareness

Pieces of digital jewellery have the ability to make people be more aware of their body and what is happening to them in moments of tension, joy, frustration or stress. *Inner* (2007) by Leah Heiss (see Figure 2.5-16) is a piece of digital jewellery prototype that deals with issues of intrapersonal understanding and allows for an awareness of our non-conscious behaviours. It focuses on foibles, oddities, idiosyncrasies and eccentricities that may allude to one's emotional state. The brooch at the neck of the jewellery senses a nervous habit, in this case touching the sternum. This information is transmuted into an internal output, softly activating solenoids which tap against the ribcage and an external output; a subtle pulsating optic fibre along the stomach. The focus is on one's idiosyncrasies and the embodied reaction to them (here touching the sternum) and not on patterns generated from biometric data. In comparison with examples of wearable

technology that detect changes of temperatures, moisture and transmit messages (see *Vein2* or *Skin-Bone*. p. 18), the piece *Inner* offers the space for self-awareness in a personal and intimate way.

Figure 2.5-16 *Inner* by Leah Heiss 2007. Silver, electronic components.

2.5.5 Digital Jewellery and Digital Sensation

The piece *Swarms* (2008) by Hazel White (see Figure 2.5-17 below) and *NECLUMI* (2014) by panGenerator (see Figure 2.5-18) invite people to experience a piece of digital jewellery as a sensation by creating a sensorial and imaginative experience for the wearer through on-screen animations or light projections. *Swarm* is made of a silver chain that has an extended digital life. As the wearer moves the chain, the computer code reacts to the movement of the chain by the wearer and creates animations of swarms to fly away. Although participants of the user study could not relate to the necklace they were wearing, they documented that the extended life of the piece on the screen as being a playful and intriguing interaction (White and Steel, 2007). Similar to *Light Projections* (1994) by Susan Heron, *Light Jewellery* triggers sensational experiences for the wearer. More specifically, the light is produced by a projection controlled by a phone application and four dynamic options respond to different inputs measured by the phone's built-in features and gyroscope projection-based jewellery pieces.

These pieces expand our understanding of what digital jewellery can be through "digital sensations" by suggesting interactions that highlight the sensorial and the imaginative aspects of digital jewellery.
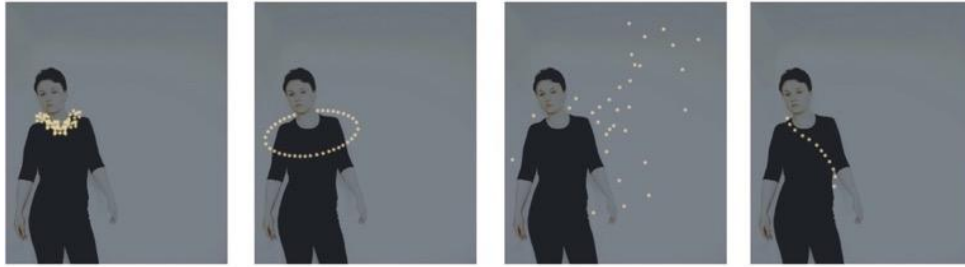
Figure 2.5-17 *Prototype modular jewellery* by Hazel White & Ewan Steel 2005. Details from the screen based visual element of the work. Silver chain, animation.
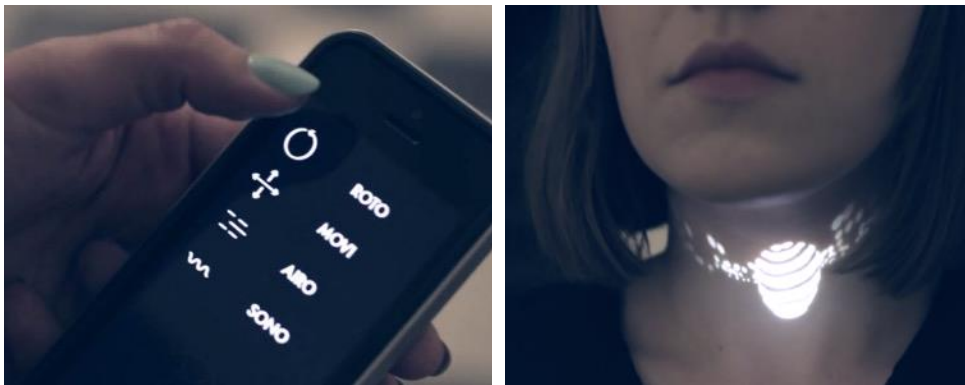
Figure 2.5-18 *NECLUMI - a probable future of jewellery?* By Collective panGenerator 2014 left: Control the projections via the phone right: Light projections. Light, mobile phone, gyroscope.

Source: Stills from the panGenerator's Video https://vimeo.com/110207736

2.5.6 Jewellery and Digital Making: New forms of participation in design

The design and fabrication of jewellery by the use of digital tools, such as CAD, 3D printing and parametric modelling. Within this space of "digital making", researchers explore the use of new materials. In this section I will present examples that are designed with computer-aided (CAD/CAM) and algorithmic processes or bio-technology and offer alternative ways of involving

participants in the design process, which can be inspiring for the field of digital jewellery.
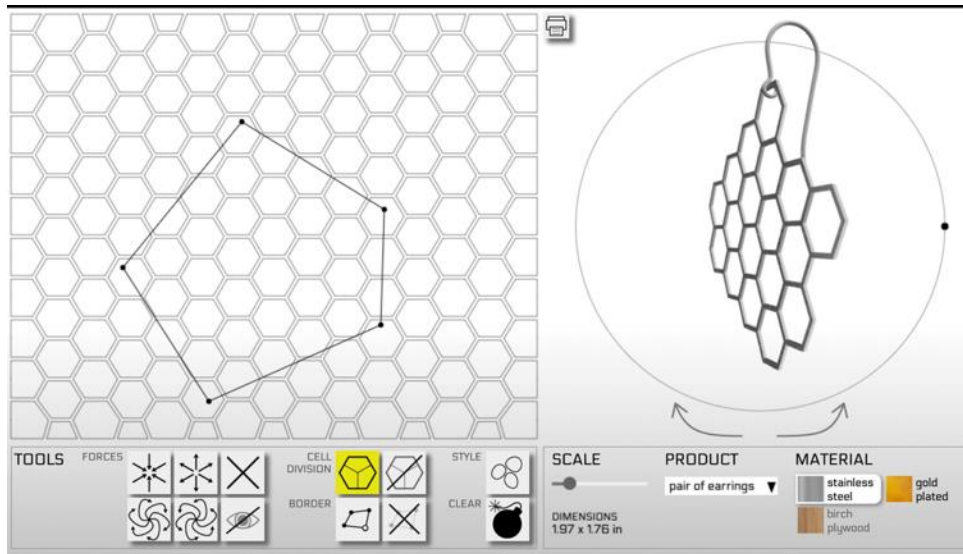
Figure 2.5-19 *Radiolara* a bio-designed inspired app by Nervous system

Source: Screenshot from https://n-e-r-v-o-u-s.com/radiolaria/ on Aug 2019

The first example I offer is the bio-inspired design application Radiolara, designed by Nervous System (see Figure 2.5-19 above). The application allows the wearer to generatively change elements of the design of the piece of jewellery. The technological advances offer new tools for designers, jewellers and people from the field of engineering to design jewellery forms in new ways. These tools offer new forms of user participation in the design process and often designers set the parameters of how people can participate in the design process. An example that suggests more intriguing interaction with digital technology during the design phase is the Virtual Orchid (2015) by Design studio Minale-Maeda. The Virtual Orchid is an encrypted 3D file which one can buy, download and print. Once the file is downloaded it can only be printed once. Similar to the previous examples, the shape of the Virtual Orchid is generated each time anew when it is bought. Although, the code has limitations and offers a pre-defined set of possibilities, its design is based on a variety of influences like location of the wearer, climate, soil, season. One can wait for different conditions to get a different orchid before purchasing. Ordering the flower at a different time or place will make the orchid change its shape, which may bring anticipation. Figure 2.5-20 shows the result of my design when I accessed the service in 2018.
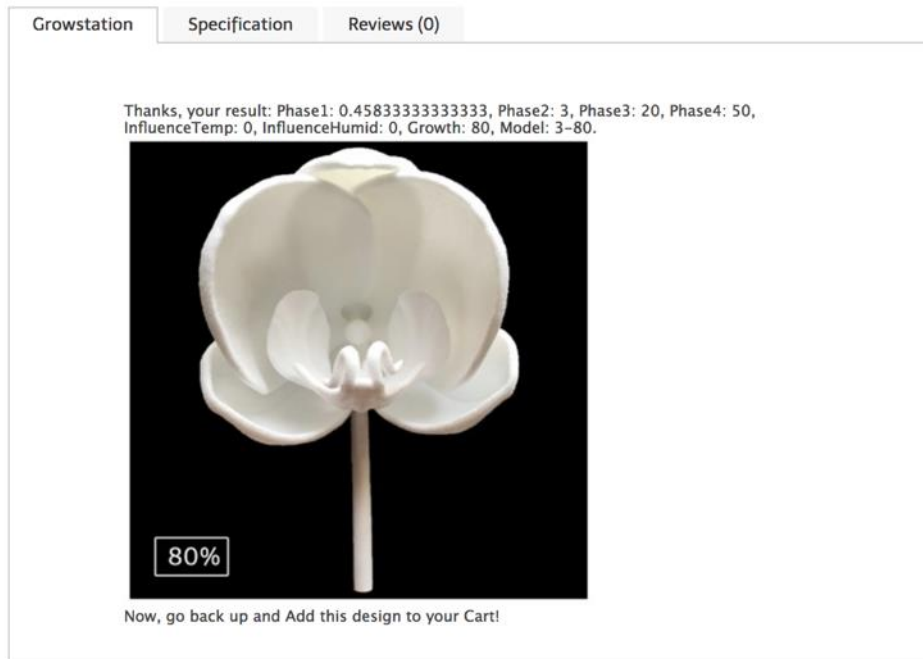
Figure 2.5-20 *Virtual Orchid* by Design studio Minale-Maeda, 2015. A screenshot of the

growth of the orchid as retrieved from a location in the UK on 29.09.2018.

studio Minale-Maeda © 2015 all rights reserved. Image courtesy of the artist

Source: http://www.tessapicks.com/index.php?route=product/

product&product_id=52

The last example I offer is from the field of bio-technology and jewellery, the research project BioJewellery (Thompson et al., 2006). Biojewellery are rings designed by bio-engineered bone tissues from two partners. The partners put a bit of themselves into the rings they wear. The project reveals ethical concerns on working with living cell which falls outside the scope of this research, however, it offers alternative approach to bespoke jewellery that brings the focus to the meaning in the material itself.

Examples such as the Virtual Orchid suggest interactions that are site and time-specific and thus intriguing and the Biojewellery project provokes a new way of thinking of bespoke design, that of the piece made literality from a part of someone's body. These examples are inspirational for the field of digital jewellery.

2.5.7 Towards an understanding of digital jewellery

Previously, I presented examples of digital jewellery that focus on the personal and emotional significance for the wearer and presented examples that open ways of discussing issues of personal values and identity. I also referred to examples that suggested alternative ways of connecting with one's bodily state and idiosyncrasies and I introduced the term *digital sensation* to refer to examples that create sensorial and imaginative experiences for the wearer. This review of existing examples of digital jewellery revealed useful insights that I summarise below:

1. **The narratives relating to the materials in digital jewellery is important**. Reflecting on existing methodologies of designing pieces of digital jewellery, materials and forms that are important for the wearer can inform the design. For example, Wallace gets her inspiration from particular individuals and fragments of the lives and experiences of the people she works with. With sensitivity to the materials (traditional and digital), she designs objects that have a close relationship to the wearer's life and memories. Similarly, White makes pieces that connect the wearer with their own narratives. For example, the form of *Lens* supports the connection between the wearer and an intimate place. Examples such as *Address* or *Vanity Ring* suggest a rich interaction between the piece and a person, yet they seem to lack a narrative element connected to their form and materiality.

2. **Digital jewellery is idiosyncratic and view the body from an experiential perspective.** Digital jewellery starts with the person and the person's values such as what makes her/him laugh, feel comfortable, and connects her/him with significant others and places in a very personal way. Digital jewellery is objects concerned with one's sense of self and emotional significance and is situated principally in the field of contemporary art jewellery to bring the focus on personal significance (Besten, 2011, Dormer and Turner, 1994). It is what makes digital jewellery able to take advantage of advances in wearable and digital technology and still stay faithful to the values behind the social and cultural role of jewellery in peoples' lives. Its fundamental function is to offer the space for personal significance and provide a link to a person's meaningful connections that can ground and support one's sense of self. In this space, digital technology is a material that offers the possibility to explore new ways of connectedness with the self, significant others and places.

Within digital jewellery practice, the relationship between the piece and the body is important. Similar to non- digital jewellery, digital jewellery gains intimacy as

objects relate to our personal narratives and as objects are placed within the personal space of the wearer. Good examples of digital jewellery do not view the body solely as something that can be measured and controlled. Rather than figures and graphs resulting, for example, from a Fitbit, the body is explored from an experiential perspective, as well as through its physical dimensions, such as body temperature and heart rate.

3. **Poetic Qualities of Interaction with Digital Jewellery for Intimate and Personal Engagement**. I will summarise the qualities of interaction in digital jewellery by focusing on atypical personal interactions with technology. This analysis builds on Olivier and Wallace (2011) premise of open and varied interpretation of the digital (read more on p.210).I refer to these qualities as *poetic qualities of interaction* (see Table 2.5-A p.42). They refer primarily to the function of the piece and the wearer's interaction with the object.

    Unique: a quality that suggests that a part of the process occurs only once; the process is not reversible or repeatable. This quality can add personal value to the interaction with a piece, as described in *Blossom* and *Lockets*.

    Anticipation: a quality that questions the pace of an interaction with the digital. The wearer anticipates the interaction and thus can reflect on the significance of the piece, as described in *Blossom*.

    Site-specific: a quality that addresses the location in which the interaction occurs. By having a unique location to connect with the piece and its content, a wearer can connect with a place or/and the piece in an intimate way, as described in the piece *Lens*.

    Intriguing: a quality that arouses the curiosity of the wearer to explore the interaction with the piece in short turns. In Lens, the picture is revealed through the interaction only in glimpses and in Swarms, the on-screen interaction is different each time.

    Sensorial: a quality that relates to the senses or the power of the digital sensation. *For two rings*, *Light Jewellery*, *Swarms* and *Inner* offer ways of connecting with one's body, via focusing on the experiential qualities of the interaction between the piece and the body.

    Imaginative: a quality that leaves the space for open interpretation or creative response to the digital, as described in the pieces *Address* and *Swarms*.

Provocative: a quality that raises social, cultural or political issues in our digital culture, such as identity as described in the piece *Vanity Ring*.

These qualities are important because they can open new possibilities for designing for personal and intimate engagement, acting as propositions for research on how digital experiences can present more poetic interactions and not definite answers. I will discuss these qualities in Section 6.1.2, when I discuss my digital jewellery.

Table 2.5-A Poetic qualities of the interaction with digital jewellery.

EXPECTATIONS OF THE DIGITAL WITHIN DIGITAL JEWELLERY PRACTICE

DEFINATE   UBIQUITOUS   INFINITE   DIRECT   PREDICTABLE   IMMEDIATE

QUALITIES OF THE DIGITAL
THE FOCUS IS ON THE FUNCTIONALITY AND EFFICIENCY OF THE PIECE
(see more on Wallace and Olivier, 2011)

PLAYFULL   INTRIGUING   SURPRISING   IMAGINATIVE   SITE -SPECIFIC   SENSATIONAL   UNIQUE   ENGAGING   ANTICIPATING   SENSORIAL

POETIC QUALITIES OF INTERACTION WITH THE DIGITAL
THE FOCUS IS ON THE PERSONAL AND INTIMATE ENGAGEMENT

4. **Making Digital Jewellery.** Within existing research in digital jewellery, the potential for craft methodologies to inform digital practices has been discussed. Heiss (2013), for example, suggests that experimental ways of making and thinking about work can enrich the development of wearable technologies because

> *A craft practitioner is not limited by technology", but "considers the whole-of-life human experience— the users, situations, environments etc.— in which the technology will be used [...] asking 'human' questions that allow technologies to become more sensitive to users' needs. (Heiss, 2013 p. 7).*

Similarly, Kettley (2011, 2016) states that craft is a reflexive process of possibilities and a protocol for designing for authenticity. She highlights that craft offers a personal connection though its process and its products as it embodies a very subjective world view (Greenhalgh, 2003, Pye, 1968). It is this personal connection between the maker and viewer through an object that is key to the craft practice. Wallace (2007) explores this relationship ever further in order to create methods that are rooted in craft that can be applied to the design of digital devices as a means of developing digital jewellery pieces that are more desirable, relevant and significant to people. In her research, objects become "stimuli" for people to

open up themselves and share with the researchers their fears, frustrations, dreams and desires.

Craft is a process of working with materials that is explorative and open, it also a skilled practice embedded in tacit knowledge and it is an approach that is personal and intimate. All three factors make craft a unique form of knowledge and intelligent making that can open new opportunities to develop its relevance in the digital age (Press, 2007, Wallace and Press, 2003, Press and Cusworth, 1997). I will return to these three aspects more fully later in Chapter 2 (Section 3.4 p.67).

Part *Two*

2.6 The context of the research: Short-term micro-transitions

As this PhD is a piece of design research, my aim here is not to provide an exhaustive account from literature on transitions that occur in the self, neither to create an expectation that I was aiming to create pieces of digital jewellery that could be tested against whether or not they eradicated uncomfortable feelings for someone. I offer an example of micro-transitions contexts as a context that we experience periodically, one that serves as a rich environment for the design of digital jewellery.

The context of the research has not been studied by other scholars and therefore there is no literature that I can draw from directly. However, as this research looks at the nuanced fluctuations in one's sense of self during the transition of travelling home periodically, I build on literature from social sciences that is based on people leaving home to study (Holdsworth and Morgan, 2005) as well as people moving "house and home" (Lee, 1968), as these are experiences that have some similarities with the context under study. I build on research studies in psychology in order to gain an understanding of how periods of transition (in more general terms) challenge a person's sense of self. Before I provide an account of the different types of transitions that occur in life and their impact on self, I will give an overview on how a sense of self is understood within the research.

2.6.1 Sense of self as becoming

By self or sense of self I refer to the unique attributes that distinguish us from others, attributes that bring different parts of our existence together by persisting through changes or opening the way to becoming who we want to be (Smith, 1978). Self in understood through its emergence and transcendence within a societal and cultural setting (Goffman, 1990), where people create narratives to

make sense of themselves, plan their lives and shape their behaviour (Giddens, 1991, McLean et al., 2007, Taylor, 1989).

The self is dialogic; it is always in relation with the other, not as binary opposition, rather in a relation of simultaneity (Holquist, 2003). To illustrate this point better I borrow Bakhtin's term "surplus of seeing" (as cited in Holquist, 2002 p.35). Bakhtin points out that we can understand ourselves through the different ways people see us and the way we see ourselves. In this process, the relation self/other is continuously re-specified, in Bakhtin's terms "consummated", through dialogue. Bakhtin suggests that each of us has a surplus of seeing about oneself and a surplus that has been given to us by others. The difference between the two is a relation of *otherness*. This suggests that only in the presence of the other, we can better understand ourselves, as each of us can see things about others that others cannot see about themselves.

McCarthy and Wright (2013, 2015) draws on the Bakhtinian dialogic philosophy to open the space for design researchers to explore ways of communicating with participants that focus on the dialogue between people involved. Their work has been very influential to my way of working. It gave me a methodological framework to engage with participants in the research. Later in the thesis (see Section 3.3 p.58) I will discuss extensively how a dialogical engagement allows participants and myself to find our own voice in the research and share aspects of self in creative ways.

Our ability to reflect on our self, something that persists over time, makes us humans through our ability to be reflexive. A person with a reasonably stable sense of self has a feeling of biographical continuity which s/he is able to grasp reflexively and, to a greater extend communicate to other people. Giddens (1991) argues that the particular mode of thinking about us that constitutes biography, or personal narrative, is fundamental to the very nature of identity formation. *"Self-identity is not a distinctive trait, or even a collection of traits, possessed by an individual. It is the self as reflexively understood by the person in terms of her or his biography"* (p.25). The flexibility of changing who we are over time derives from our accountability (Harré and Secord, 1972). Accountability is our ability to reflect upon our actions and give them certain meaning. We simultaneously attempt to be both flexible as accounting beings (ibid.) by adjusting to different social settings, while also maintaining a core continuous self in order to cope through periods of transitions and major tensions in life.

2.6.2 Transitions as a Challenge to our Sense of Self

Transitional experiences in general terms are periods of time in which a person's sense of self is significantly unsettled or altered. It is a period of perceived low control (Fisher, 1990). More specifically, the loss of control over the environment associated with the process of moving home is one of the experiences assessed on scale by Lee (1968). On a more personal level, transitions challenge the coherence of a self-narrative (Pals, 2006). In other words, transitions challenge the continuity of sense of self over time. Stability and changeability have been a consistent feature of the study of transitions within psychology. This can be seen in the work of significant figures such as Erikson (1977) when discussing moments of crises and Piaget (1976) most notably conceptualising them as a disequilibrium. Within design research, transitions have been characterised as being periods of transformation; an interplay between the changing and unchanging dimensions of body, role, interactions, habits, and environments (Ozenc, 2014). According to Ozenc (2014) transition occur when a person is in the midst of passing from one state to another and usually challenges an individual's well-being in physical, emotional, social, and spiritual dimensions. In such periods, well-being is not a state, but rather an ongoing effort for harmony (ibid.).

Fisher (1990) and Holdsworth and Morgan (2005) identify that attempts to manage an imbalance to self are a key characteristic within periods of transition. A shift in one's inner world during transitions are almost inevitably accompanied by change (Cowan and Cowan, 2012). Cowan and Cowan (2012) propose a definition of role transitions that I find useful in understanding how such periods affect one's self. They offer a description of life transitions as being "long-term processes that result in qualitative reorganisation of both inner life and external behaviour" (p.5). How s/he manages this reorganisation and unsettling to whatever an individual identifies as a usual sense of self is central to how one and gains control and copes (or does not cope) with the transition itself (Brim Jr and Ryff, 1980). In such periods, it is valuable to understand someone's experience and to offer support (Ozenc, 2014, Nicholson, 1990) in order to prevent feelings of "lostness" and disorientation in the new environment (Lee, 1968).

2.6.3 Sense of Self in Short-term Micro Transitions

Individuals experience a number of transitions within their lives: beginning school, changing school, leaving school, getting married, becoming parents, getting divorced, beginning and leaving employment, to name just a few. The list, if not endless, is potentially very large. Indeed, it can be said that life is organised around transitions (Holdsworth and Morgan, 2005) and some are given particular or more personal significance. In this section, I will break this down further by drawing on the types of transitions and their impact on self respectively.

Holdsworth and Morgan (2005) characterised transitions in occurring at both macro and micro levels. Macro transitions are concerned with regularities of changes and structures in the overall patterning of transitions within a particular society; such as migration or unemployment. A micro level transition is concerned with experiences, negotiations and meanings in a personal setting. In this research, I am concerned with the personal experiences of transitions. By focusing on micro-transitions, I am asserting a distinction between the major life transitions that a mass or group experience and the subtler change(s) to one's individual sense of self. Rather than major life transitions such as marriage, childbirth or mourning a loved one (ibid), I use the term "short-term micro-transitions" to refer to the more everyday encounters that can cause nuanced unsettling to what one perceives, personally, to be a stable sense of life and of self. By reflecting on my own lived experience, I have been able to identify a particular context of short-term micro-transition for research enquiry – the context of living in a country that is not one's country of origin and travelling between both locations periodically. The nuanced fluctuations in one's sense of self, experienced during journeying between two locations/countries, both considered home are the short-term micro-transitions that are the context for imagining, designing and making digital jewellery in this research enquiry.

Scholars in psychology and sociology have extensively discussed how critical turning points in life, such as a loss (Klass et al., 2014), displacement (Casey, 1993, Dixon and Durrheim, 2000) or role transitions (Cowan and Cowan, 2012) can bring significant changes to one's sense of self. Significantly less attention has been given to transitions that I characterise as being short-term. Whilst less dramatic and not as easily attributable to a specific event, short-term transitions are nonetheless contexts of experience that can disturb our personal equilibrium causing us to seek forms of comfort. How we can find ways to adjust to the

changes experienced and manage these transitions are rich contexts for the design of digital technologies and (in particular) personal meaningful digital artefacts, such as digital jewellery.

2.7 Summary

In Part *One*, I presented existing nomenclature of digital jewellery. I offered a critical review on views of the body and the self in the field of wearable technology. In doing so, I revealed that there still is a very limited perspective on what digital jewellery can be in our lives and I asserted that research that focuses on the experiential qualities of digital jewellery is critical and necessary. To uncover the rich potential of digital jewellery I examined the field from a contemporary jewellery perspective and I presented examples that focus on human life with its complexities and individuals with their idiosyncrasies. These examples transcend the limits that digital technology imposes on our imagination by rebelling against its value system, presenting alternative approaches to designing digital worn objects that are personal and meaningful to individuals. They open alternative ways of connecting with one's personal memories, significant others and intimate places or creating the space for bodily awareness in subtle ways.

In Part *Two*, I defined short-term micro-transitions as being experiences that happen occasionally in which our sense of self is in flux and experiences a period of re-adjustment to something more familiar and grounded. These experiences pose challenges to individuals in socio-spatial and a personal level. My assertion is that short-term micro-transitions are experiences that we each face periodically, arguably frequently in contexts and specificities aligned to our lives that gives us a rich backdrop for the designing of digital jewellery. I have identified, therefore, a new rich context for jewellers to make things for and a context for digital technologies to be attentive to/tuned to the changes to sense of self.

In the next chapter (Chapter 3) I describe my methodological approaches to this inquiry.

3 Methodology

This chapter gives an overview of my approach to this research from the perspective of a design practitioner and a researcher. The purpose of this chapter is to present an account of my approach to this research in order for others to understand my focus, my experience and my way of working. This is not an account to help others replicate my approach, however hopefully it will help people understand why I have made the decisions I have made throughout my research.

In Section 3.1, I present the current methodological debates taking place within the two most relevant fields to this research; digital jewellery and research through design. This aims to clarify my position on both subjects.

In Section 3.2, I frame my methodological stances based on the previous sections and define my methodology and methods. In this section, I highlight a dialogical approach to design (Section 3.3) as my philosophical grounding. This work builds upon a craft-based research-through-design practice (Section 3.4). The autobiographical elements are key feature of my approach.

In Section 3.5, I present the value of authentic contexts of place in design research and I draw on the atmosphere of planes and airports to situate my methodological decision to organise *the Air[craft] Workshop* (see p.108).

The field of digital jewellery is very small with only a few researchers investigating its boundaries. Thus, I have chosen to expand my review to related fields in order to talk about certain qualities of digital objects that inform my understanding of meaningful interactions with technology. In Section 3.6, I discuss lived and felt experience with technology, enchantment, ludic engagement and poetic imagination.

In Section 3.7, I discuss the role of the resulting digital jewellery in the research to act as provocations within a small group of experts to discuss the current state and future of the field of digital jewellery. This discussion was structured based on the Delphi Method. I discuss its relevance and the adaptations I made for the purpose of this research.

3.1 My Position to this Research

Digital jewellery is situated principally in the field of contemporary art jewellery (Cheung, 2006, Dormer and Turner, 1994) where jewellery is developed and researched not for 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). Contemporary jewellery spans the contexts of fine art practice (Astfalck et al., 2005), design practice and craft practice (Dormer and Turner, 1994). Thus, the design of digital jewellery inevitably encompasses aspects of art, craft, and design.

Broadly speaking, design currently falls into the following categories: designing objects (Mazanti, 2011) to designing for services (Meroni and Sangiorgi, 2016, Yee et al., 2013) and organisational management (Young et al., 2017) and systems thinking (Luhmann et al., 2013). This research focuses on the aspects of design that are concerned with the production of artefacts and meaning. In engaging with the digital, contemporary jewellery, through the practice of designing digital jewellery, is also encompassing aspects of human-computer interaction (HCI). Thus, as a design practitioner and design researcher in the field of digital jewellery, I am working at the intersection of art, craft, design and HCI.

My approach throughout this research is concerned with taking on the role of a maker and concurrently taking on the role of a researcher. The aim of this multiplicity of roles was to enable me to carry out a creative process by producing reflective artefacts that acted as a way to produce knowledge (Nimkulrat, 2012). This approach to research is often labelled as being practice-based, practice-led or practice-related research (Nimkulrat, 2007, Scrivener, 2009). Often these terms are used interchangeably (Candy, 2006) whereas others challenge this divide in the first place (Frayling, 2015). This discussion is not an important part of this PhD. However, I highlight that, within my research, practice is a central and integral part of the process and involves making artefacts as a constructive approach to research (Koskinen et al., 2011), and therefore, it involved working with the emergent and debated paradigm of Research Through Design (RtD).

The role of practice in the production and dissemination of new knowledge in Design and HCI research has been an issue for debate (Durrant et al., 2015, Wallace et al., 2014). In those debates, some scholars attempted to generalise the knowledge derived from practice, raising issues of validity and replicability of research methods and findings (Stappers and Giaccardi, Zimmerman et al., 2007).

On the other hand, others advocated for the generative nature of RtD (Gaver, 2012, Wallace et al., 2014), as it *"tends to be provisional, contingent and aspirational"* (Gaver, 2012 p.938). I follow those who embrace the 'messy' nature of practice and the explorative nature of the inquiry, acknowledging that acts of making can serve as valuable ways to explore and express feelings about different contexts (Frayling, 2015, Gaver, 2012, Wallace et al., 2014) without the aim to generate generalizable knowledge that fits neatly into one of the definitions of RtD.

I highlight that RtD is an approach, an ethos that I take as a maker to conduct research though the practice of design. RtD is not a singular research method or approach to doing design research (Mattelmäki and Matthews, 2009, Stephan and Ben, 2014). More specifically, Wensveen & Matthews (2014) discussed that there is wide spectrum of examples and roles for *research through design,* where design practice is understood as a basis for research.

RtD's nature is exploratory rather than hypothesis testing due to the qualitative method of this approach. Therefore, it would be inappropriate to attempt to scientifically explain or quantify the outcomes of this study. Instead, methods developed and knowledge emerged as my research progressed through reflective practice. My way of working can best be described using Sullivan's (2010) term *unknown to the known* to describe practices "*whereby imaginative leaps are made into what we don't know as this can lead to critical insights that can change what we know*" (p. 48). This approach to research differs from conventional practices where new knowledge is constructed by building on *"established methods [that] make use of accepted conversions and practices",* which he refers to as *from known to unknown* (p.50). Explorative approaches to research involve data that are created rather than collected and making is conceived to be the driving source. (ibid.)

Ingold's (2013) *Thinking Through Making* is an important reference point to this research. In relation to Sullivan's term from unknown to known, Ingold uses the term *creativity forwards* to describe making as a process where ideas are generated in the flow and transformation of materials and under the sensory awareness of the maker. The materialisations of ideas are constantly in a progress of growth, becoming and changing (Ingold, 2007). Ingold (2009) states that

> *Neither brick nor mortar, nor soil, nor the ingredients in the kitchen, nor paints and oils, are objects. They are materials. And what people do with materials, is to follow them, weaving their own lines of becoming into the texture of material flows comprising the lifeworld (Ingold, 2009 p.96).*

This quote encapsulates my view on the role of making in my research, which I will describe in greater detail in the next section, where I am going to discuss my RtD approach.

3.2 My Research Through Design approach

My Research through Design (RtD) approach is based on two key elements; craft practice and a dialogical engagement with people. These elements utilise practice in different contexts in order to understand the richness of a lived experience. My RtD is illustrate below as an umbrella (see Figure 3.2-1) that I am "holding" whilst I was conducting my research. I also imagine that each researcher might have their own umbrella (each research through design process) that is different and unique, however, each can be rigorous in its approach through systematic reflection and ongoing documentation. Ultimately, I imagine each researcher's umbrella shelters them from the rain, but each in its own way.
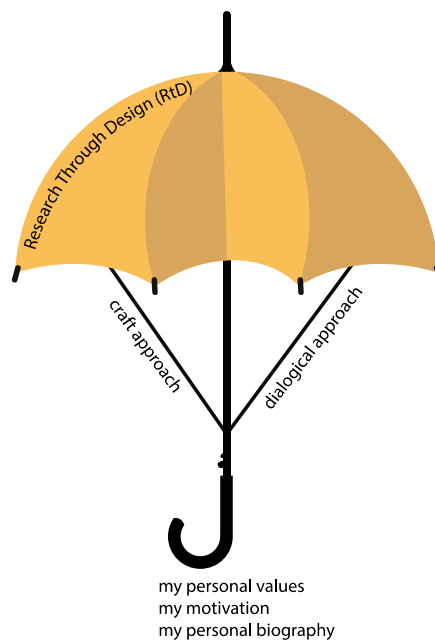
Figure 3.2-1 My approach to Research through Design

In particular, my research is characterised by activities of making (including participatory design practices), together with rigorous reflections with a view

towards design outcomes. Through making, I gained a better understanding of the field of enquiry, which subsequently informed different parts of my study. Throughout the study, various forms of making occurred and reoccurred, not necessarily in sequential order. This includes exploring materials, making methods for engagement and making digital jewellery. These forms of making are outlined below (see Figure 3.2-2) and I will describe them in detail, in Chapter 4 Making (to follow). These activities of making were not in isolation; they happened in dialogue with people (experts, other practitioners and participants in the study). Dialogue informed and added richness to my field of enquiry (see p. 57).
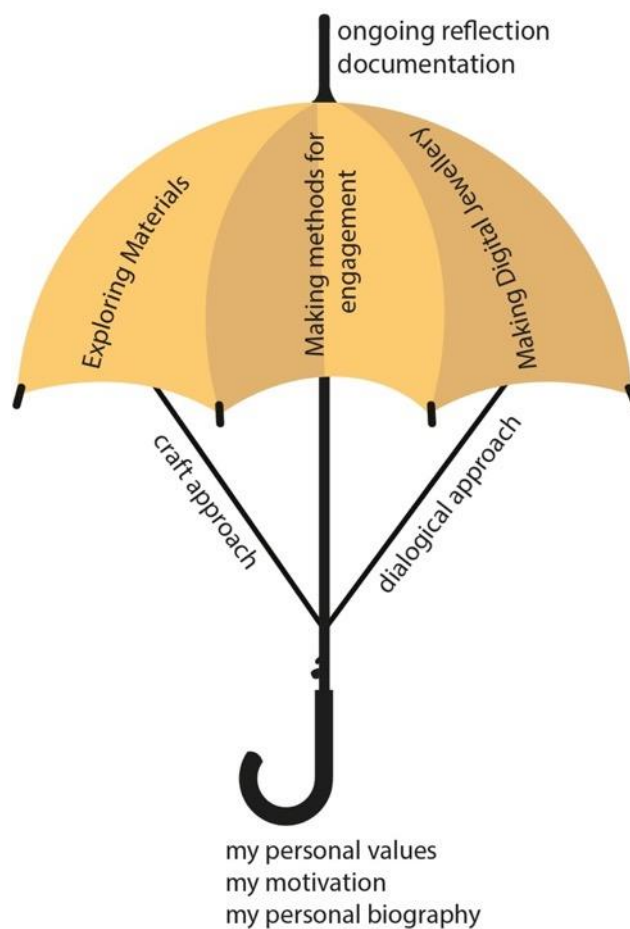
Figure 3.2-2 Key elements of my Research through Design approach

There are four elements described within this thesis that aim to capture key elements of my practice and the qualities of my practice that enabled me to generate knowledge about the nature of digital jewellery. These four elements are: exploring materials, making methods for engagement, making digital jewellery, and the documentation and sharing of insights.

Making Methods for Engagement: Dialogical Approach (see Section 3.3 p.58) and Craft Approach (see Section 3.4 p.69): In the inception of this PhD journey, I drew upon my personal biography and my own experiences to explore what it means and feels to be a person during a micro-transition and I brought insights from my explorations into my participatory engagements with others in order to construct a dialogue. Situating the research within the broader context of experience-centred design, I drew heavily on McCarthy and Wright's (2015a) understanding of dialogue to guide my methodological decisions on this part of the research. In designing methods for participatory engagement, I explored creative ways to share aspects of my sense of self with the participants and I let them find the space to share with me how they felt and describe what mattered to them in the context. I have built upon existing methods in design to understand lived experiences (such as probes and theatre methods) to open up a creative space for participants to share aspects of a sense of self within micro-transitions. Such methods are used to develop mutual responsive relationships where both participants and the researcher can benefit from the participation.

Exploring Materials: To Craft is to Think-through-making (see Section3.4.1 p.68): This part of my work is characterised by the exploration of materials and meaning and has offered new perspectives on the field of my enquiry. In this part of my work, I explore the *digital* and *wearable technology* and conceptually frame these as being new "materials" within contemporary jewellery. This framing allows me to explore the experiential qualities of digital technology as a material that can be shaped, formed and controlled as a jeweller might do with silver. This aims to help makers consider digital technology in the same way they might consider atomic elements that are familiar to jewellers, such as copper, silver, gold and platinum and in the same way they might consider composite materials that are familiar to them, such as plastics, ceramics and textiles. In order to understand digital as a material, I tried to understand the possibilities and limitations of working with digital electronics by learning the basics of coding and electronics, via working closely with a creative technologist throughout the study.

Making Digital Jewellery (See Section 3.6 p.75 and Section 4.9 p.149): This part of my work relied on my skills in crafting jewellery alongside my new-found skill in constructing electronic objects. By reflecting on my lived experience of being in transitional situations and the experience of my participants, I developed knowledge models for digital jewellery centred on supporting the sense of self.

Using these new models, I framed new roles for digital jewellery. These framings led to the development of prototypes that embody my knowledge and direction of digital jewellery. The resulting digital jewellery can best be described as *research archetypes* using Wensveen & Matthews (2014) terminology, in which its form, function, interactivity, etc. embodies a theoretical proposition that can be subjected to test new ways of conceptualising digital jewellery (see more Section 3.7 p.79).

Documentation of research process and ongoing reflections: A RtD approach can be rigorous but not in the same way as scientific research. Rigorous RtD looks at the motivations behind design decisions, as suggested by Storni (2015), this means explicitly discussing embedded assumptions, rationales, and criteria for inclusions and exclusions of concepts, of particular types of users, of design features. A systematic documentation plays a crucial role in my research process as it supports the practitioner's reflections (Cross, 2001, Scrivener, 2009) in a form that the researcher can revisit and analyse in order to develop and construct design knowledge (Mäkelä and Nimkulrat, 2011).

A recent call for annotated portfolios (Bowers, 2012) seems to point toward an improved accountability of RtD. Other forms of disseminating the research process have been suggested such as RtD Comics (Dykes et al., 2016).

Throughout the study, I designed a number of magazines, which I describe as issueNo# (examples are shown on Figure 3.2-3 and Appendix A). Table 3.2-A shows the chronology of their development throughout the research. The role of these magazines was to capture reflections about my practice, to document design outcomes and to share findings with a range of audiences. The discursive style of writing, which is markedly different to academic writing, alongside the strong visual content, aimed to create an engaging tool for capturing ongoing reflections on practice and communicating these reflections with participants in the research process. The printed format included different themes and issues related to jewellery, digital jewellery, the body and the sense of self through short-term micro-transitions.
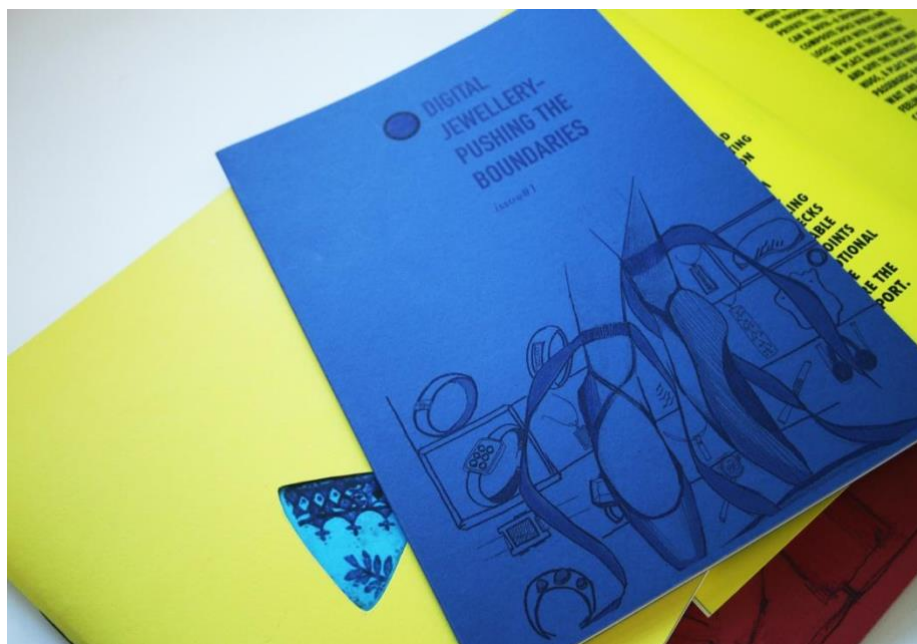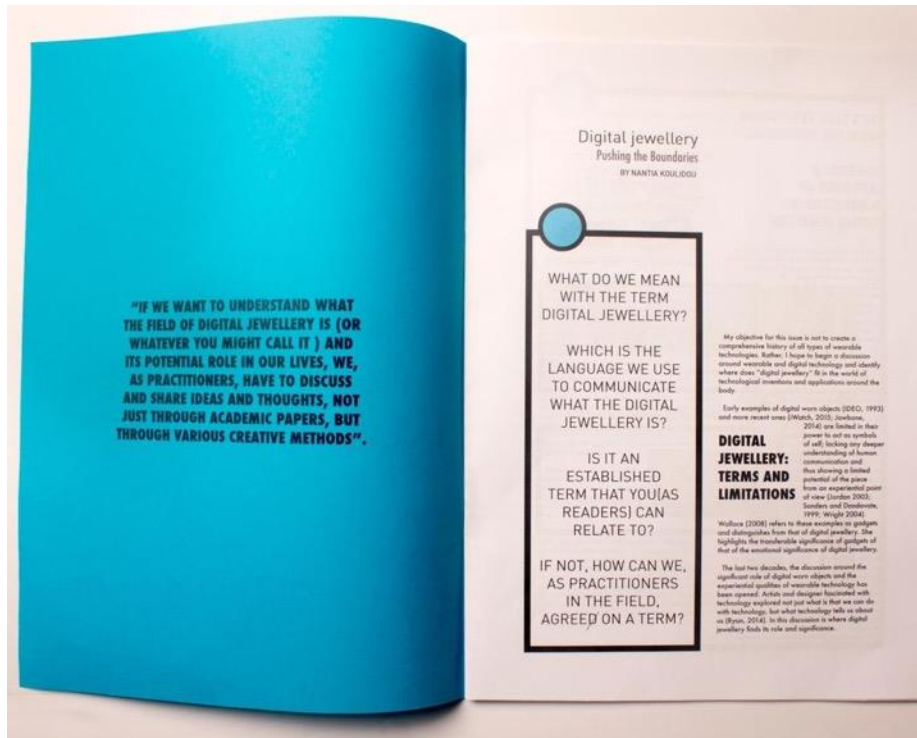
Figure 3.2-3 IssueNo#. Visual documents capture ongoing reflections throughout the research.

Source: Personal archive

Table 3.3-A. Design activities and collaborations are presented in chronological order (March 2015 - November 2018)
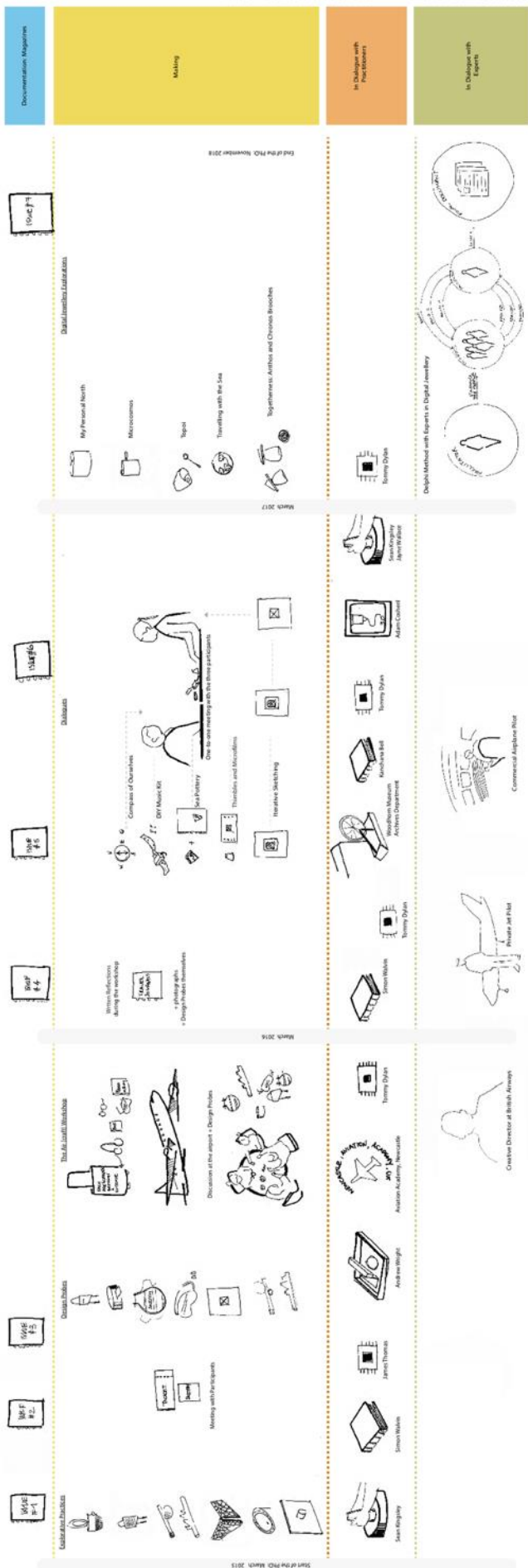
3.3 Dialogical Approach to Design

I found useful the notion of dialogicallity within HCI research to guide my methodological decisions on the participatory part of the research. In this section, I describe what I mean by a dialogical approach to design and I present existing methods that I will draw on for the purpose of this research. The specific methods for engagement that I have designed for the context of this research will follow in Chapter 4 where I will talk about the Air[craft] workshop and the Design Probes I developed throughout the research.

McCarthy and Wright's (2015) premise of a dialogical approach to design is that dialogue is understood as being a mutually responsive relationship rooted in trust and empathetic engagement with the other. More specifically, a dialogical approach to communication focuses on the processes between the people involved (rather than, in some cases, what each has to say). In a mutual and responsive relationship, participants and researchers blend their perspectives whilst maintaining their position and voice: "*It is in the presence of another person's voice that brings [participants'] particular perspective and experience into dialogue*" (p.64). McCarthy and Wright's (2015) quote Bakhtin to suggest that each participant brings to the design activity, in Bakhtin's terms, an *outsideness*, which is the essence of an empathetic engagement. It is only through this *outsideness* that people can understand each other and themselves (Wright and McCarthy, 2005). In their own words, dialogue is:

> *Something more than conversation or interaction. [...] One's sense of self is formed in responsive communication with others, within which a growing recognition of the other person's perspective and voice as something other nourishes a growing sense of self with a distinctive voice and perspective (McCarthy and Wright's, 2015 p.11).*

Taking a dialogical approach to design enables me to conduct research that offers a creative space which enables people to be themselves and define themselves within a participatory engagement while keeping each other's voice distinct. Participants and I (as design researchers, people who experience similar situations) are coming into this exchange as different, yet equal points of value that will learn and exchange ideas as a result of the dialogue and thus experience genuine surprise (Wright and McCarthy, 2005). *"In a dialogical creative space [...] participants self-define as they continuously configure and reconfigure their participation."* (McCarthy and Wright, 2015a p.81).

With this theoretical framing in mind, I built upon existing creative methods in design in order to understand lived experience such as the probe approach (Gaver et al 1999; Wallace 2008; Wilde 2010) and theatre methods (Brandt and Grunnet, 2000, Rice et al., 2007, Ryöppy et al., 2015, Vines et al., 2014). Before I describe the methods developed in this research (see Chapter 4 to follow), I will unpick the reasons why I decided to use design probes and sketching, theatre methods and the actual environment of airplanes and airports in order to elicit rich reflections on participants' lived experiences.

3.3.1 Autoethnography

As the research has elements of autobiographical experiences of transitions, I start by reflecting on my position within this research. In my research process autoethnography was a parallel exploration of my own experience and my participants' lived experience (Ellis et al., 2011) of travelling between two homes. For clarity, autoethnography is a method through which researchers can explore and portray the culture where a phenomenon is being experienced. There are different uses of the term and it varies according to the researcher's personal experience and the phenomenon under investigation (Foster et al., 2006). I adhere to the description given by Ellis (2007) who states that *"autoethnography is a back and forth movement between examining a vulnerable self and observing and revealing the broader context of that experience"* (p.373).

The purposes of autoethnography may be as varied as the topics it deals with. However, as Ellis and Bochner (2011) discussed, writing accounts of research should always have the goal of informing and educating others, which is an objective that autoethnographies might accomplish through making connections with personal experiences of readers. Within the context of my research my goal was to make these connections with the participants. I achieved that through sharing my personal motivations and feelings of transition throughout the research. As emphasised by Plummer (2001) *"What matters [in autoethnography] is the way in which the story enables the reader to enter the subjective world of the teller - to see the world from her or his point of view, even if this world does not 'match reality"* (p.401).

From the early stages of the research, my personal narratives were captured in objects and sketches. Some of these personal explorations became probe objects within the participatory engagements. This illustrates an important

advantage of the method, as discussed by Mendez (2013); its potential to contribute to other's lives by making them reflect on and empathise with the narratives presented. This way of working is dialogical (McCarthy and Wright, 2015a).

3.3.2 The Value of Design Probes

In recent academic literature, there have been a number of papers that suggest probes help designers gain a rich understanding of people's lived experiences (Gaver et al., 1999, 2004a, Graham et al., 2007, Mattelmäki, 2005, Wallace and Lindley, 2014). Probes are invitations, similar to the method *"tickets to talk"* (Sacks, 1992) in supporting dialogue about the past, present and future; encouraging participants to talk about their lives and experiences in an open and often uncertain way (Gaver et al., 2004a). They are commonly described as being creative tools for participatory research that pose questions through objects through exploratory, lateral and playful means as opposed to the neat, rigid process of gaining responses to questions (Mattelmäki, 2005, Sanders and Stappers, 2014). They have been used to enrich the co-creative, empathetic context between a participant and a design researcher (Wallace and Lindley, 2014, Wallace et al., 2013).

Probes should not merely be seen as a method to inspire design, but as a method to engage and encourage participants to talk about their lives and experiences in an open and often uncertain way (Gaver et al., 2004a) and a tool to establish a dialogical relationship between researchers and participants (Wallace et al., 2013). Making probes work can be challenging however (ibid.), and as documented by Gaver et al. (2004a) and Boehner et al. (2012, 2007) the method is often misunderstood. Some commentators have argued that the probe method has become somewhat standardized in its deployment, (Boehner et al., 2012, 2007). They argue that the subjective mark and expression of designers evident in the process of designing probes is increasingly lost and that probes commonly only inform the final design of a system, losing an important stage which could advance the conversation between designers and participants.

There are significant challenges in designing and deploying probes to be sensitive to both the participant and the context. Moreover, participants can find it challenging to articulate aspects of their lives as it can be far from straightforward for people to express their feelings (Wallace and Lindley, 2014, 2013). Thus, it is worth further exploring methods that may help people feel as comfortable as

possible to share aspects of self with the design researcher.

I see probes as being a valuable tool to gain a rich understanding of people's transitional lived experiences when designed within the probe approach (Boehner et al., 2012), as well as to create an imaginative space where participants will discover new ideas for design (Wilde, 2010a, 2009). I believe that researchers should be prepared to let the method unfold over time and see the method as a way to open a creative space between the researcher and participants so that new meanings can emerge though dialogue and not as an activity that people have to complete. I align with McCarthy and Wright's (2015a) thinking that, for the method to be dialogical, researchers ought to give participants alternative ways to find their voice and propose different alternative *ways in* to the conversation. It is useful to consider that the probe approach is not inherently participatory, and as Graham and Rouncefield (2008) argue, how the method is chosen and deployed should be where the design community dedicate more attention. I believe that some of the challenges of using probes within a design context could be overcome when designers follow a dialogical approach (see Section 3.3) where traditional categories of designer and user, researcher and participant, are challenged (McCarthy and Wright, 2015b).

As I outlined earlier in the thesis (see Section 3.4.1.1) that my approach to designing probes is embedded in craft practice. Within this approach, Wallace's (2013) framework for the design of the probes set the grounding for my explorations. In her analysis of a series of design probes centred on a sense of self and personal significance, Wallace highlights the value of: (1) openness and boundedness of the probes, (2) the pace that the information is revealed, and (3) the reciprocity of the probes. Each of these factors are key to creating a reflective and reflexive relationship (Wallace et al., 2013) between myself and the participants. Alongside her framework, I explore estrangement (4) as being a quality to the probes to help people imagine new kinds of technologies (Wilde and Andersen, 2009).

To follow, I describe in detail how I interpreted these qualities of probes to fit the purpose of this research.

(1) One prerequisite for my probe approach to be designed around a sense of self is that probes should "*offer a participant both openness to share whatever [they feel] appropriate and clear boundaries to respond within*" (Wallace, 2013 p.3444). A probe may have different kinds of openings in metaphorical terms, and

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openings give us different kinds of information about the person and his/her values and experiences. The openness of a probe could be around a theme which gives a particular frame for response. The form of the probe asks its own questions, thereby leaving room for people to imagine different scenarios of what an object is or could be (see also estrangement).

(2) In my work, pace refers to how the information is revealed to question aspects of self. The body and its interaction with the probes is important for my exploration on jewellery and sense of self.

(3) Probes are objects that embody a personal and empathetic way to ask questions. They are objects that shows care and respect to the participants' feelings, values and sense of self.

(4) Wilde (2010a, 2009) presents estrangement as being a quality of probes. This insight was developed from the OWL body props project and it is an attribute that I adopted as part of my own probe approach. Similar to the aim of this research, the aim of the OWL project was to imagine new kinds of technologies on the body and, more specifically, to create an emergent, imaginative space where people will both discover and articulate what each body-device is. Wilde (2010a) suggests that *"it is easy to be vague and wistful when discussing the unknown, we are using these techniques in order to have very precise and detailed conversations about objects and possibilities that do not exist."* (p.189).

Probes that are unfamiliar or ambiguous in form can potentially create the space for participants to create new layers in the objects and imagine new concepts for digital objects. These qualities are interpreted and presented in Chapter 4 where I talk about the specific set of probes that I designed for the *Air[craft] workshop* (see Section 4.5).

3.3.3 The Value of Sketching

In my attempt to make design probes that are dialogical and open for the participants to find their voice in the research, I used the medium of sketching. Sketching relates to the participants' and my own design practice and is a medium that I have used to go through my own transitions (see Figure 3.3-1). Drawing on existing research and my own practice, I used sketching as a way to find gentle and imaginative ways to share with the participants' feelings about micro-transitions and, in turn, for them to share aspects of their lives in visual ways (see Chapter 4,

Section 4.7 where I am going to talk about how the method of sketching evolved with the participants). This way of working is rooted within my craft practice.

In the following sections I will expand on the value of sketching: a) as a way of discovering new ideas through making (see Section 3.3.3.1) and b) as a visual method which offers a personal and interpretative space for people to explore aspects of their sense of self (see Section 3.3.3.2). In Section 3.3.3.3 I will present two examples of how sketching has been used in art and design research that inspired me to use sketching as a method of capturing experiences and feelings.

Figure 3.3-1 My feelings. First impressions from Newcastle by Nantia Koulidou, 2015. Ink on paper.

3.3.3.1 Discovering New Ideas Through Sketching

For clarity, I refer to sketches as being explorative drawings to communicate ideas with others. Sketching is an intuitive and iterative process of self-discovery where ideas and thoughts are communicated through a form of dialogue. Pallasma (2009) defines sketching as being *"a fully haptic and multi-sensory reality of imagination"* where the hand-eye-mind and the sketch are in continuous dialogue that leads to the development of thoughts and ideas in unintended ways" (p.59) .

Among others, Brodsky (1993) emphasises that the significance of the sketch for the maker arises from (and is defined by) the process, rather than being a mere a pre-conception. During the process of sketching, new relationships are created on

the sketching surface, resulting in what Schön called the drawing's "backtalk" (Schon, 1984). More specifically, a sketcher sees in his/her sketches new clues, which in combination with his/her mental configurations can trigger new meaning and development in unintended ways.

Pallasmaa (2009) and Gedenryd (1998) agree that it is impossible to know if the line on the paper comes first or if it is the thought of an intention: *"In the arduous processes of designing, the hand often takes the lead in the probing for a vision, a vague inkling that it eventually turns into sketch, a materialisation of an idea"* (Pallasmaa 2009, p.8).

Sketching from a craft perspective opens the dialogue between the sketcher and her/him self. In the process of sketching, a negotiation between the self, the other and the sketch is taking place that I found this process particularly useful to form a dialogical understanding between the participants and myself. The following quote captures this negotiation and understanding of self well:

> *Drawing is a process of observation and expression, receiving and giving, at the same time. It is always a result of yet another kind of double perspective; a drawing looks simultaneously outwards and inwards, to the observed or imagined world, and into the draughtsman 's own persona and mental world. Each sketch and drawing contain a part of the maker and his/her mental world, at the same time that it represents an object or vista in the real world, or in an imagined universe. Every drawing is also an excavation into the drawer's past and memory (Pallasmaa, 2009 p.90-91)*

3.3.3.2 Sketching is Interpretative

The ambiguity of a sketch is another valuable feature of the sketching process. Buxton (2010) stated that *"[…] much of [a sketch's] value derives from it being able to be interpreted in different ways, and new relationships are seen within them, even by the person who drew them"* (Buxton, 2010, p.113).

This ability to interpret sketches and excavate them for information is inherent to all of us from an early age (Goldschmidt, 1994). From children's' drawings to the sketches of a skilled designer, the sketch is in conversation with oneself where "*one reads off the sketch more information than was invested in the making*" (p.164). The practice of sketching helps to discover previously hidden qualities or characteristics of an emergent design. This feature can be also explored in sketches of lived experiences, such as in Berger's sketched responses to his deceased

father. On reflection, looking at the drawings that he made in front of his father's coffin, he scarcely sees a deceased man; instead he sees aspects of his father's life. Unlike a photograph (that represents reality), a drawing contains the experience of looking and has its own time, thereby offering a space for new interpretations. Berger (1993) describes that *"For each form, between the pencil marks and the white paper they marked, there was now a door through which moments of a life could enter [...]"* (p.42).

3.3.3.3 Sketching as a Method to form Dialogue

I offer two examples of how visual dialogue has been used in research in order to better articulate the angle that I have come from in the development of my sketching method (see Section 4.7 p.125)

The first example is the work of Tolia-Kelly's (2007) visual methodology on capturing migrants' emotional and sensory responses to the Lake District landscape in the UK through drawings and paintings. The participants in this research visited a site in the Lake District in the UK and took part in creative workshops where they were encouraged to visually record their feelings. Participants' drawings and recordings from the workshops formed the basis of 40 paintings made by the landscape artist Graham Lowe as part of the project. The artist further added his interpretation of the group responses retrospectively to the artworks. The final pieces were presented in an exhibition that aimed to offer a space for dialogue. I see this example of practice as the start of a method of visual dialogue that aims to create a space where people can share their feelings and thoughts.

The second example I offer is Blythe's (2010) use of portraiture to create a subtle space for discussion with elderly in a care facility. Here, the researcher collaborated with artist Phil Reynolds to create creative responses to people's feelings in the context of the care home. The artist and the researcher created portraits of the elderly as an artistic gesture during the meetings. In this example, what is significant is the use of sketching as a method to allow intimate engagement between participants and researchers in challenging situations.

Tolia-Kelly's visual methodology inspired me to explore a way of looking at sketching within design practice as a medium of expressing one's feelings and emotions, inviting others for an open-ended interpretation of one's sense of self.

The use of sketching in Blythe's exploration revealed that people felt comfortable to share nuances of their lived experience in the care home, which supports that sketches can be "tickets to talk" (Sacks, 1992). Drawing on my own practice of using sketching to capture my feelings of moving countries and existing literature, I see the potential of using sketching as a method of capturing experiences and feelings in this research.

3.3.4 The Value of Theatre Methods

Theatre methods invite participants and researchers to engage in different forms of participation, thus enabling them to explore different ways of understanding their own self, others and the design of a product or a system. This has particularly contributed the methods used in design research to obtain meaningful data from research participants, something which is valuable to this research.

Design and HCI researchers have worked with theatre professionals in order to understand people lived experiences with technology and to provoke responses. From a user-centred design approach, theatre methods in design have used body storming (Oulasvirta et al., 2003), user enactments (Odom et al., 2012) experience prototyping (Buchenau and Suri, 2000), in early stages of the design process to increase designers' empathy towards the other person or a system (Brandt and Grunnet, 2000, Rice et al., 2007). In the more recent experience-centred design work, Vines et al (2014) argued that live theatre has specific qualities that benefit the forming of a dialogue between participants and researchers when compared to pre-recorded film and scenarios. Live theatre is a 'common ground' between audience participants and actors in the facilitation of new ideas which stimulates interest and new understanding about a context (ibid.).

Alongside the more traditional forms of theatre methods, I see elements of post-dramatic performances as being valuable in creating settings for participants to be themselves and to explore their transitional lived experience. Postdramatic Theatre (Carlson, 2004) more broadly, "*combines site-specific and immersive performances, which are centred around the ambiguous experiences of participants*" (p. 592). Practitioners base their work upon their own bodies, their own autobiographies and their own specific experience in the world and the

spectators do not observe but experience themselves inside of a time-space. Fischer-Lichte (2008) highlights that such practices destabilises how one thinks about one's self in a context. Similarly, McKenzie (2001) points out that postdramatic theatre has the ability to place both the performers and the audience within a transitional space that exists between the norms of everyday life and the norms established during performance events. Such space invites spectators to be performers and to rethink their positions and attitudes (Carlson, 2004).

Postdramatic methods have been applied to fields of consulting, mediating, counselling, and psychodrama with great effect in order to elicit emotional responses and reflection (Amundson and Thrift, 2008, Liamputtong and Rumbold, 2008). However, there has been little discussion concerning the way in which the dynamics of post-dramatic methods can bring insights into people's lived experiences. One example is Object Theatre (Ryöppy and Skouby, 2015) where designers and practitioners have been experimenting to create the opportunity for participants to lose control, improvise and take a perspective of an object in order to explore the social, material and symbolic meaning of objects. In the performance, the manipulation of objects and their physical properties is its essence.

I see a great potential in exploring methods of post-dramatic performances within my design practice to create a setting for participants to be themselves and explore their lived experience. Thinking of theatre methods in design can potentially open new ways of engaging people in a dialogical form of participation, where the boundaries between researcher and participant are blurred within the performance. Theatre methods have been used within my design practice during the *Air[craft] workshop* (see Section 4.5).

3.4 Craft approach to Design

Craft is an important part of my RtD approach in two ways.

Firstly, I use "to craft" to refer to explorations and understandings of the possibilities of materials. In this sense, craft is defined through making as a way of thinking-through-making acknowledging the dynamic relationship between materials and people as a way of dealing with the complex, the messy and the

uncertain (Ingold, 2007, 2009, 2013).

Secondly, I use *to craft* to refer to the making methods of engagement and the final digital jewellery pieces that embodies my personal biography and the lived experiences of the women who I engaged with the research. Such a way of working is evident in contemporary jewellery practice, although rarely articulated as such (see Chapter 2. p.24). Drawing on existing methodologies in designing digital jewellery, I discuss Jefferies's term "to craft is to care" (as cited in Hung and Magliaro, 2010) in relation to working on a personal scale.

3.4.1 "To craft" is to Think-through-Making

Considering craft as a process of thinking-through-making is well acknowledged in the existing literature. The writer and craftsman David Pye (1968) articulates that craft is about judgment, dexterity, and care as opposed to predetermining results in advance of something being made. An influential writer within the craft and jewellery literature, Peter Dormer (1994) states that craft as a process enables the craftsman not only to achieve a goal, *"it also enables [the craftsman] to imagine what his/her goal might look like"* (p.19). Similarly, Adamson (2007) states that "*craft only exists in motion. It is a way of doing things, not a classification of objects, institutions, or people*" (p. 4). More recently, the curator, writer and artist Janice Jefferies (as cited in Hung and Magliaro, 2010) highlights that, *"as a verb, craft is active. It is about doing and moving forward"* (p. 12) and Martina Margetts (2011) argues that *"making is a process where mind, body and imagination are integrated in the process of thought through action"* (p.39). From a practitioner's point of view, the English ceramicist Edmund de Waal (2011) observes that craft is an unstable set of possibilities or experiences. He asserts that:

> *Craft is a starting place, a set of possibilities. It avoids absolutes, certainties, over robust definitions, solace. It offers places, interstices, where objects and people meet. It is unstable, contingent. It is about experience. It is about desire. It can be beautiful. (de Waal, 2011)*

From these perspectives in the literature, I define craft as a way of thinking-through-making that can help researchers in research in digital jewellery build knowledge in a dynamic way.

The concept of the *material,* as a subject to be the focus of craft, is not limited

in this research to physical materials such as silver, clay, paper and wood. The concept is also applied to the digital material and the compositional relationships between both the physical and the digital. From a craft perspective, materials (traditional and digital) play an essential role in a maker's actions, reactions and making processes, which I believe cannot and should not be reduced into theoretical abstractions.

My background, skill set and idiosyncratic characteristics influenced the research significantly. As a trained silversmith and architect, I used my skill-set and I worked with metal, 3d-modelling and digital fabrications, model making, and drawing. However, I also explored other materials such as ceramics, resin and modelling putty. In a search for meaningful interactions, I worked with electronic components that were available to me. From the early stages of the research, I engaged in work that explored the potential of digital technologies with a creative technologist and I familiarised myself with the new material by learning the basics of coding and prototyping with electronics.

Through a process of thinking-through-making I gained an understanding of the possibilities of combining digital technology and jewellery practices from a first-hand perspective.

3.4.1.1 To care is "to craft"

In the previous section, I discussed craft as a process of working with materials that is explorative and open. It is also an intimate and empathic process that fuses learned knowledge of making with the desire to create objects for people (Paz, 1974, Wallace and Press, 2004). Craft offers a personal connection though its process and its products as it embodies a very subjective world view (Greenhalgh, 2003, Pye, 1968). It is this personal connection between the maker and viewer through an object that is key to the craft practice.

3.4.1.2 Crafted objects embody personal meaning

The human is ever-present in a crafted object, both in the trace of a maker and in the process of making (Kettley, 2016, Wallace et al., 2013). Dormer (1995)

articulates that craft knowledge has a public aspect, which includes the dialogue with other practitioners and a personal aspect as it *"becomes a part of the self"* (p.18). It seems impossible to detach the trace of the maker from the process of making in craft. Hung and Magliaro (2010), editors of the book *By Hand: The Use of Craft in Contemporary Art*, introduce the work of artists who used craft within their practice and describe it as:

> *Thirty-two participants [who] are unafraid of letting a bit of themselves show through in their final products. They are happy to leave their fingerprints in their work in an attempt to get closer to their own lives and to the lives of others (Hung and Magliaro, 2010 p.8).*

De Waal (2000), describes the relationship between the craft object and the maker as:

> *a language of form that a maker makes his or her own, something that has developed intuitively through making, and notably, something that arises from the complex context of a maker's biography. That craft objects are who we have been and who we are becoming. (De Waal, 2000)*

The maker's sensitivity on materials and making processes is an important element of my design process of digital jewellery.

3.4.1.3 Craft as an approach to person-centred design

Craft, to be useful in the digital making age, must be able to be adopted by person-centred approaches in order to maintain its relevance (Press, 2011, Wallace and Press, 2003, Wallace and Press, 2004). Press (2011) demonstrates that the relevance of craft in the twenty-first century is in the craft *knowledge*, as opposed to craft *products* and he puts the emphasis on craft sensibilities and sensitivities. This knowledge, and its ability to create sensitivity in an object, allows the object to become significant in person-centred design approaches.

Dormer (1997) extensively wrote that craft knowledge is highly individual, based on, and arising from, experience. In his words:

> *Craft, with making as its central activity, is all bound in with tacit knowledge and connoisseurship – knowledge that cannot be described very easily but which can often be demonstrated. Because it cannot be described easily, it is very hard to draw down into general principles. But the facts of the knowledge can be demonstrated through example and*

comparison. (Dormer, 1997 p. 229).

Jefferies (2010) has written that "*To craft is to care [...] [it] implies working on a personal scale - acting locally in reaction to anonymous globalised, industrial production.*" (p.12). Jefferies implies that makers care about the object and its impact on people on a personal scale, an attribute important in person-centred design approaches. It is these qualities of the crafted objects that can act so powerfully to trigger memories, affections, and stories in a person (ibid).

The idea of making something with care for someone represents something highly personal and emotionally charged. I suggest using the phrase "To care is to craft", which implies that we must care in order to craft well. By reversing the order of Jefferies' statement, I intend to place emphasis on care being a prerequisite of craft. Thus, in order to craft we must care. I believe that this approach to craft can be valuable in the design of digital jewellery.

To summarise, craft is seen in the research as a process of working with materials that is explorative and open. It also a skilled practice embedded in tacit knowledge and it is an approach that is personal and intimate. All three factors make craft a unique form of knowledge and intelligent making that can open new opportunities to develop its relevance in the digital age (Press, 2007, Wallace and Press, 2003, Press and Cusworth, 1997).

3.5 The Value of Authentic Contexts of Place

In the context of this research, I also explored the value of authentic environments in eliciting rich insights. This exploration draws on early examples of experience prototyping practices (Buchenau and Suri, 2000) where designers engaged themselves in real contexts in order to understand existing user experiences, the context and to explore design ideas. Designers took an actual train journey, where they acted out scenarios to better understand certain experiences. In their recent paper exploring a method they call experience prototyping, Buchenau and Suri (2000) investigated passenger's needs for a new rail service by role-playing and improvisation during a real train journey. These designers valued the actual space where experience takes place and argued that a real setting gives them the permission to observe live passengers' experiences and "*explore what*

experiences would be like for a particular person in a particular context through dramatic improvisation" (p.427). They also created staged environments using foam mock-ups and props in order to better understand a setting such as the interior of a plane. Simulating the interior of a full-scale airplane or by taking an actual train journey, designers could better understand a certain experience and generate and evaluate ideas in the early stages of the design process.

Others have argued that we can better understand a context by "being there" (Oulasvirta et al., 2003) and suggested that designers should prefer the "*identical or very similar locations over staged, because of getting accurate conception of the studied activity*" (p.132). I strengthen this argument by looking at the notion of atmospheres of place. The concept of atmosphere (see Section 3.5.1) helped me to take the methodological decision to bring the participants of the study into an authentic environment and unfold the experiential qualities of airplanes and the airport (see Section 3.5.2).

In this research, I draw the attention to the specificities of the airplanes and airports as places with certain atmospheres that people experience during the physical transition. Airports and planes are liminal spaces (Andrews and Roberts, 2012) that we pass through as part of the physical transition one undertakes when travelling from one country/place to another. Such places have a certain atmosphere that we can only fully experience by "being there" (Oulasvirta et al., 2003). I move on in this chapter to discuss the notion of the atmospheres, where I draw from architectural theory and phenomenology to describe the value of working in-situ and the particularities of the space of airplanes and airports.

3.5.1 Atmospheres

> *I enter a building, see a room, and – in the fraction of a second – have this feeling about it. What on earth is it that moves me? Everything. The things themselves, the people, the air, noises, sound, colours, material presences, textures, forms too. […] (p.13) What else moved me? My mood, my feelings, the sense of expectations that filled me while I was sitting there. (Zumthor, 2006. p.16)*

Atmospheres can be encountered in everyday language as ambience, a sense of place, or tempered spaces and can be perceived through our emotional sensibilities (Zumthor, 2006). Everything in our surroundings creates the mood: the things themselves, people, the air, noises, sounds, colours, material presence, textures and

forms (ibid). While an atmosphere might be *"a certain mood or emotive tone permeating a particular environment"* attuning the mood of an individual, it may also merge with how an individual feel (Bohme, 1993).

The notion of atmosphere has been conceptualised by philosophers (Bohme, 1993) and discussed in practice by many architects (Borch et al., 2014, Pallasmaa, 2016, Zumthor, 2006). In the design disciplines, the significance of atmospheres has received less attention. Exceptions can be found in works addressing the 'bodily felt experience' in space (Kinch, 2011).

The architect and theorist Jusami Pallasmaa (2012) stated, *'an atmosphere is an experience of the in-betweeness of subject and object in which the emotive and sensory experience are central."*(p. 41). He quotes Heidegger (1962) and gives a rich description of an atmosphere of a space:

> *As we enter a space, the space enters us, and the experience is essentially an exchange and fusion of the object and the subject. Seen in this way, atmospheres shape a person's being-in-the-world as a whole: the relationship to the environments, to the people, to things and the most genuine way of accessing them is through bodily presence. (Heidegger 1962, as cited in Pallasmaa, 2012, p. 232)*

When we become aware of the atmospheres around us we can address questions such as: *How do I experience the space in which I find myself here?* and *How do I feel in this space?*

3.5.2 The Value of In-situ: The Atmosphere of Airplanes and Airports

From a phenomenological perspective, the way we experience spaces is through our bodily felt experience and is multi-sensorial and emotive (Pallasmaa, 2012). Our experience of being in airports and aeroplanes is a fusion of our bodily relationship with the built environment, the objects and other people around us and the way we feel about ourselves during the different parts of the journey.

As we are being transported across distances we experience different relationships between the space we temporary inhabit and our bodies. Sitting in the condensed space of the aeroplane seat, for example, with the seat belt fastened, limits our bodily movements and our comfort is a completely different bodily experience from sitting in the chair in our office. Some people experience a tension

on their body during the take-off (or the landing) due to environmental changes, nervousness, excitement or the fear of flying. During the flight, our body and the objects around us respond to the physical environment (air-pressure, difference in temperature) and they are in a constant adjustment to the situation. The close proximity to other people and the seat in front defines our personal space and creates a setting for social interaction with strangers.

The physical transition is often linked with the rituals of travelling (with control and checks and) a process of decoding signs to stay connected. However, our understanding of the space is *"extended beyond its physicality to its capacity to connect us with other types of spaces by contradicting and inverting the sites that it connects"* (Fuller and Harley, 2004 p.105).

Being in transit is an emotive experience influenced by the purpose of the journey. For example, our experience of flying will be different when anticipating arrival at a holiday destination, rather than a work engagement or a visit home to meet people we love. In different parts of the journey we experience a variety of audio-visual stimulus. The signs at the airport, the cabin crew announcements, the sounds of the announcement machine, the sounds of taking off and landing, the experience of being over the clouds, sitting by the window or by the alley, as are parts of the actual experience of how the space affects the sense of self in the context.

In this research, I draw the attention to the specificities of the airplanes and airports as places with certain atmospheres that people experience during the physical transition. Airports and planes are liminal spaces (Andrews and Roberts, 2012) that we pass through as part of the physical transition one undertakes when travelling from one country/place to another. Such places have a certain atmosphere that we can only fully experience by "being there" (Oulasvirta et al., 2003).

3.6 Making Digital Jewellery

We do not just use technology, we live with it, it is a part of our 'felt-life' and can create magical moments that would not be possible without it. (McCarthy and Wright, 2004 p.27)

In this section I will examine qualities of digital objects that inform my practice of making digital jewellery. I will review literature in digital jewellery, however, as the field of digital jewellery is very small with only a few researchers investigating its boundaries, I have chosen here to expand my review to related fields in order to develop a richer understanding of meaningful interactions with technology. In the field of HCI, the designer's role is to design digital technology that can create rich and personally meaningful experiences for people. Given the number of researches that has explored the *aesthetics of interaction* (e.g. Ross, 2010, Forlizzi and Ford, 2000; Davis, 2003; McCarthy and Wright, 2004; Overbeeke and Wensveen, 2003), I will not provide an extensive review of existing theories and models. Instead, I will offer an understanding of digital qualities for digital jewellery and I will present two examples that contribute to a more holistic conception of digitally jewellery that includes broader conceptual thinking and production as two key components of a digital jewellery approach.

I will discuss an approach of designing digital jewellery that is based on a lived and felt experience with technology and more specific the notion of enchantment.

3.6.1 An Approach based on Experience

My understanding of experience is rooted in Dewey's *Art as Experience* (Dewey, 2005) which depicts the experiential dimension of human life as being a continuous transformative flow that never finds a final rest. Browning (1999) describes the experience that Dewey finds essential to human life by stating:

> *Day after day we find ourselves within an integral part of those ever-changing and always unique situations that constitute our lives and mark out their shifting horizons. Each of us is bound within this situational stream, a stream which is never at rest, always in transit. We cannot stop it or freeze it even for a second…. [T]his stream of situations in our lives is precisely that to which Dewey refers by the term 'experience'.(Browning, 1999 p.24)*

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Pragmatic aesthetics in experience-centred design provides a firm theoretical framework from which a variety of concepts can be explored; these include curiosity, joy, playfulness, surprise, and enchantment (Petersen et al., 2004, Wright et al., 2003). Pragmatism sees aesthetics as a particular kind of experience that emerges in the interplay between user, context, culture, history and technology. In attempting to design digital jewellery as an experience that can create meaningful and rich interactions, a practitioner must first try to understand what experiences are. In the description of experiences from the perspective of pragmatic aesthetics, I take my focus from the practice of experience-cantered design where a felt life of experiences with technology is central to the approach (Wright and McCarthy, 2010, McCarthy and Wright, 2015b).

This idea of a lived and felt experience with technology as being a driver for research mirrors an anthropological approach that places empirical data at the heart of research. This understanding is key in designing digital jewellery because it asks the practitioner to prioritise empirical observations as a starting point of research for digital jewellery. This understanding of experiences with technology is consistent with the pragmatist notion of aesthetic experience (Dewey, 2005).

This work is relevant to this research because it places the emphasis on the researcher as a concerned and feeling person engaged with technology and making sense of themselves and their interactions with (and through) technology. From this point, a researcher is able to better understand the notion of 'felt-life', an approach that acknowledges the tight relationship between what people do and how they feel about, give value to, and give meaning to what they do and what has happened to them (Wright and McCarthy, 2010), p.63. Bradley (2005) summarises a felt experience as being:

> *[…]whatever a person does in the here and now, how they feel about it, the response they receive and how they feel about that, their sense of how what is happening relates to what has happened in the past and in the future, we see people making meaning of what is "going on" around and "within" them, a process that mixes memory, desire, anticipation, relations with others, cultural patterns, bodily feelings, sights, smells and sounds. (cited inWright and McCarthy, 2010 p.2).*

Such an approach to experience is a promising path to follow in the context of designing for rich experiences for people with digital jewellery, as it rejects the body/mind dualism and places a focus on the rational mind in favour of a holistic understanding of being a person.

This approach to experience is part of an ever-present interest in the fields of Interaction Design and HCI, both of which aim to understand human experiences with designed objects which are presented through research and which focus on emotional and experiential designs (Van Hinte, 1997, Jordan, 2000, Monk et al., 2002, Norman, 2004). These approaches to technology go beyond usability goals and strive to define the experiential aspects of the interaction with an account based on the sensual, emotional, social and cultural aspects of peoples' relationships with technology. This aspect of being lost in an experience with technology is closely aligned to notion of enchantment (Wright and McCarthy (2005).

3.6.1.1 Enchantment

Wright and McCarthy (2005) reference Bennet (2001) to define enchantment as being: *"the experience of being caught up and carried away, in which, although we are disoriented, perception and attention are heightened"*(p.5). This concept of enchantment contributes to creating depth in an object that allows it to contain the possibility for complex interactions and layered interpretation, even a kind of interpretation that might surprises the interpreter. The notion of enchantment serves as a catalyst for exploring new interaction designs with digital jewellery with enchantment being a function of the object (McCarthy and Wright, 2004, Wallace and Dearden, 2005).

Wallace's (2008, 2011) work on digital jewellery acts as a commentary on current assumptions of digital technology, offering "a more varied pace of accessibility and a more imaginative conception of the blurring between the private and public aspects of our interactions" (Olivier and Wallace, 2009 p.213-14). She offers a way of viewing digital jewellery with digital capabilities "in an atypical way, one that echoes and values the fleeting quality of our experiences [with digital technology]". This introduces a set of qualities associated with digital objects that of being unique, unpredictable and open to interpretation. Their work is important as it opens new possibilities for designing for personal engagement, acting as propositions for research on how digital experiences can present more poetic interactions and not definite answers.

More specifically, Olivier and Wallace (2009) wrote about the qualities of the digital that we experience on a daily basis as being something: immediate,

ubiquitous, repeatable, replicable, infinite and deterministic. They critiqued current expectations of digital devices as "predictable, unsurprising and closed to interpretation" (p.213) suggesting that a way of looking at digital devices as fragile and transient can open the scope of the design of digital devices. This approach to digital technology informs my design practice. This work are fundamental thinking in this space. I have built upon these and I develop them further through explorative practice.

To further clarify this notion of enchantment, I will describe two examples of digital objects that support my approach to designing digital jewellery and its ability to enchant a person through their interaction with the jewellery.

The *Drift Table* by Bill Gaver (2004b) is a coffee table with a small viewport showing a slowly changing aerial view of the British landscape. Shifting weights on the table changes its apparent height, direction and speed. With about a terabyte of photography of England and Wales available for viewing, the table may be used to explore the countryside, travel to a friend's house, explore questions about geography, or simply to watch the world go by.

The *HipDisk* by Danielle Wilde (2009) is a self-contained wearable sonic output system for performance and play that exploits changing relationships between hip and torso to actuate simple tones. By physically and visually extending the body, the interface enables a sonic extension and demarcation of gesture. In doing so, it demands, provokes, requires and seems to inspire gestural extension in unexpected ways.

Gaver's work introduces the concept of ludic engagement with objects that goes beyond utilitarian activities to playful interactions with digital technology, offering alternative framings for digital technology. He states that "*[..] ludic is an attitude of engagement in the exploration and production of meaning*" (p.888). It is the openness and ambiguity of the interaction with The Drift Table that leaves room for multiple interpretations and layers of meaning. As Gaver (2004b) puts it:

> *Inherent to the notion of a device that isn't 'for' anything is the crucial role of users in appropriating the situation it offers. In a very real sense, the design isn't complete until it has been used: until then, openness undermines the ability to suggest scenarios of use with any confidence. (p.893)*

Wilde's (2010b) body-worn devices leave room for people to explore their embodied self through movement. *HipDisk* is an example where the interactive

element of the piece *"allows [people] to enter and experiment with non-verbal relationships to space and sound and allows us to consciously engage with these elements."* (p.183). It provides different ways that different people engage their imagination with their bodies.

Wilde's explorations introduce the concept of poetic imagination as being a valid approach to design for rich experience with technology when focused on extension and movement. To poeticise experience through technology is to create opportunities for different people to engage their imagination with their bodies and engage (in unexpected ways) in unusual or unexpected contexts. The interaction with physically engaging body-worn devices is *"a process of creation, reflection and construction of new physical states and levels of conscious awareness, as a direct result of interaction between body movement and the effects of technology"* (Wilde, 2009 p.36). The poetry in Wilde's work is in this new relationship formed between physical movement and the effects of technology.

Wilde's physically worn-devices and Gaver's *Drift Table* are enchanting in their own ways, by opening new opportunities and the potential for digital technology to be referred to as objects that create an interaction based on ludic engagement and poetic imagination respectively. These explorations guide my approach to designing digital jewellery.

3.7 Discussing Digital Jewellery with Experts

My research started with a basic premise was to identify opportunities for digital jewellery to support sense of self through micro-transitions. To achieve this, I reviewed critically existing examples and I made my own examples of digital jewellery. The pieces developed through my RtD practice acts as design propositions within a small group of experts 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. This approach reflects on the role of artefacts as manifestations (Lim et al., 2008, Stappers and Giaccardi, Stephan and Ben, 2014) in exploring new design spaces. Lim et al. (2008) propose an extensive discussion of prototypes in design, defining prototypes as *"filters that traverse a design space"* and as *"manifestations of design ideas that*

concretize and externalize conceptual ideas"(p.7:3). Wensveen and Matthews (2014) have identified four types of prototyping in design research and they 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).

In order to capture different dimensions of the same phenomenon, I used an adapted Delphi method prompting discussions on the values and characteristics of digital jewellery among a small group of experts. Such a triangulation gave me a more detailed and balanced understanding of the data by responding to the objects that were produced as a result of my participants' input and my own reflections. In the following section, I briefly describe the Delphi Method and its relevance to this research (insights as have arisen from the discussion with the experts will follow in Section 5.1 p.181).

3.7.1 Adapted Delphi Method

The Delphi method is a structured communication technique or method, originally developed as a systematic, interactive forecasting method which relies on a panel of experts (Linstone and Turoff, 1975). It was originally developed the in the 1950s and named after the ancient Greek temple where the Oracle of Delphi could be found.

The relevance of the Delphi technique in this research was seen in its ability to bring a group of experts together as a whole to discuss a complex problem with the goal of reaching consensus. Grisham (2009) states that the Delphi method has been demonstrated in the literature as being a reliable empirical method for consensus reaching in a number of areas; in a design context (Dalkey and Helmer, 1963, Aftab and Young, 2016), in the field of education (Yousuf, 2007), healthcare (McKenna, 1994) and business (Brill et al., 2006, Grisham, 2009). Brill et al. (2006 as cited in Grisham 2009) describes the Delphi method as *"a particularly good research method for deriving consensus among a group of individuals having expertise on a particular topic where information sought is subjective and where participants are separated by physical distance"* (p.116). These references assured me that Delphi is a method that could bring together experts in digital jewellery (who are physically dispersed) to discuss my pieces and the current state and future of digital jewellery more broadly. They could collectively develop their

understanding of this emerging field within jewellery practice.

Theoretical studies indicate that Delphi (as a group facilitation technique) carries out a series of iterations to reach consensus (Hasson et al., 2000) with each stage building on the results obtained from the preceding stages, thereby getting experts closer to consensus. According to Rikkonen et al. (2006 as cited in Grisham, 2009) a use of the method is the *"structuring of a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem"* (p.115). Additionally, a regular feedback from the facilitator allows experts to change past opinions and improve communication (McKenna, 1994).

In the Delphi technique, the experts do not know who the other experts are during the process (McKenna, 1994). In that way, the technique is intended to remove the bias that is possible when diverse groups of experts meet together or are allowed to share their opinions without judgement. As the boundaries of the field of digital jewellery are not clear and there is not a consensus on terminology or associated values, anonymising the responses can be valuable to this research. This element of the method is important to this research as it allows the experts to express their thoughts and opinion openly within the group.

Mc Kenna (1994) highlights that the biggest challenge for Delphi technique is the selection of experts which may vary in number. He believes that selecting experts from the same school of thought makes the outcome of any Delphi technique invalid and inaccurate. Tapio (2000) supports this critique and suggests that experts in Delphi must be chosen from various perspectives and experiences, so that consensus can be effectively achieved on a given subject. Hasson et al. (2000) goes one step further to suggest that the panel of experts selected should be impartial, and should participate in all the iterations, so that the information obtained reflects the current state of knowledge and perceptions. For the purposes of my work, an expert was defined as being a person that has at least three years of experience in the field of digital jewellery as both practitioner and researcher. This decision was taken because digital jewellery is such a new field. As the field of digital jewellery is rich but very small, there is only a small number of researchers internationally currently researching the field from a jeweller's perspective, of whom eight were invited to the discussion and six accepted the invitation. These experts come from a variety of higher educational institutions and practices of digital jewellery which, as suggested by scholars (Dalkey and Helmer, 1963, Grisham, 2009, Hasson et al., 2000, Linstone and Turoff, 1975, McKenna, 1994) is

valuable to the validity of the method. This means that the group involved in the Delphi gives a breadth of knowledge and experiences in the discussion.

Time and limitations of the study led to three rounds of the method being conducted. Each round had one question that was sent to all the participants via an email. More specifically, when I received the answer to the first question, I collated the responses in a visual document and send it back to them alongside the second question and a summary of the key themes (which arose from the data). Some of the respondents found it a challenge to respond to the questions within the given deadline (a few days). Therefore, I adapted the method by giving them the flexibility to drop out of the conversation and drop in when they had the time. In this way, two of respondents engaged in the conversation at later stages. At the end of the process, all the questions (with their answers) were sent back to the experts in a visual document included in my analysis.

Even though not all the respondents answered all the questions, I took all the responses into consideration for my analysis. As suggested by Grisham (2009), I was prepared to "*adjust the schedule and the communication and keep a balance between intrusive communication and a paucity of communication* (p.121). By keeping all the responses, I wanted to show that I valued the time that the respondents spend on this activity and acknowledge their contribution to this discussion. Analytical software (Nvivo) was utilised to analyse the responses, and provide feedback to the participants on the central tendencies (means) and on the levels of dispersion (standard deviation). The answers were categorised into themes which I present in Section 5.1 in Chapter 5 (p. 181).

The Delphi method presents the opportunity to start defining digital jewellery as an emerging field of jewellery. However, as I have presented earlier, it was necessary to make adaptations to suit the small number of experts in the field. The field of digital jewellery has not yet been defined collectively by jewellers. This is the first attempt of a group of experts, who are physically dispersed to consider collectively the boundaries of the discipline and its characteristics. I acknowledge that the process has not been applied in the large scale normally expected. Nevertheless, the adapted Delphi method ensured flexibility, transparency and confidentiality for all the experts and it is a significant step towards revealing the current role and future of digital jewellery.

3.8 Summary

In this chapter, I positioned myself within the current debates of research through design and digital jewellery and I presented my methodological decisions in different parts of the research. I outlined that through making and design activities I challenged my understanding of digital jewellery and I developed it further in dialogue with participants.

Firstly, I drew on my personal experience to explore what it means and feels to be a person during a micro-transition. I investigated the role digital technology as a material within contemporary jewellery to explore the experiential qualities of digital jewellery from a maker's perspective and foster new understanding of my practice as a digital jeweller. Following this, I explored creative ways to share aspects of my sense of self with the participants and let them find the space to share with me how they feel and what matters to them in the context. Situating the research within the broader context of experience-centred design, I drew heavily on McCarthy and Wright's (2015) understanding of dialogue to set my methodological decisions on this part of the research. I built upon existing methods in design to understand lived experiences such as probes, theatre methods and sketching to open up a creative space for participants to share aspects of sense of self within micro-transitions. Such methods aimed to develop mutual responsive relationships where both participants and the researcher can benefit from the participation. To triangulate my research findings and open a discourse on the current values and future practices of digital jewellery, I adapted the Delphi Technique with a small group of experts in the field.

My approach to creating methods of engagement and designing digital jewellery is rooted in my craft practice as an approach to the design in the digital age that values the complexity and uniqueness of being human. Craft approaches create many different directions for research that can be pursued. These directions cannot be clearly identified at the start of the research, thus there are elements of work that if we look back upon do not have a clear place within the research narrative. However, these explorations are an essential element of my research process because they helped to develop my thinking and my understanding of micro-transitions, of sense of self, of home and of digital jewellery. Some of these explorations are presented in the next chapter. These include my explorative phase, the participatory engagements with the participants, my digital jewellery and the engagements with experts in the field of aviation and the field of digital jewellery.

4 Making

This chapter includes all my making activities throughout the research. To help the reader navigate through this long chapter, I offer an outline of each section with a short description. The activities are not presented here in chronological order (see Table 3.2-B p. 57). This is predominantly a descriptive chapter; however, it does include my reflections-in-action during the making phases.

Section 4.2 presents the explorative phase of my PhD research. As I have outlined in the previous chapter part of my approach in conducting this research was thinking-though-making. This is a short section that presents my initial explorations that helped me start making as part of my thinking process. In this element of my research, I explored materials and I developed my understanding of the possibilities and limitations of working with electronics. I achieved this by learning the basics of coding and electronics.

Section 4.3 presents examples of practice where I was starting to think about concepts and interactions, rather than materials alone. I will describe two objects that I designed as thought pieces (*Let it Go* and *Hide&Seek*) that provoked my first conceptions on digital jewellery and I ran a co-design activity with my mother where we were looking of ways of sharing our feelings with means other than words alone. Alongside this, I gathered insights that helped me develop my understanding of the nuances of the experience of being a person in flux. From that point onwards, I was able to explore more fully my ideas and move forward with the research with a range of participants. Ultimately, these explorations inspired the probes objects I designed for the *Air[craft] workshop* and dialogical ways of working with the participants. In this section, I will also describe the *Personal North* piece and its development. The idea is a proof of concept of a piece of digital jewellery that has not been developed further due to challenges with the making process as well as the time limit to complete this research. It has been, however, an exploration where I have learned some of the challenges of making digital jewellery.

Section 4.4 describes the initial meeting I had with each participant to introduce them to the research and Section 4.5 describes *the Ai[craft] workshop*, an explorative workshop that I organised for the participants to stimulate their reflections when journeying back to their country of origin. The workshop had two parts: a) a two hours activity on a stationary plane at an airport and b) one hour discussion following the plane experience that took place in the airport terminal building. I will describe the setting of the workshop and the activities that I introduced.

Section 4.6 presents the conversations that I had with several experts in aviation throughout the course of my research. These different conversations helped to frame my research and various experts in their fields helped me answer some questions I had about flights, airplanes and air travel in general.

Throughout the research, I used sketching to capture and share with each person things that they shared with me about personal aspects of transitions for them. Section 4.7 describes a method of iterative sketching that I have created for the purpose of this research and how the participants evolved with it or not.

After the workshop, I spent time collating the probe responses and making my own designerly reactions to these as a means to immerse myself within them and to start to form some ideas that could suggest designs of digital jewellery. In dialogue with Jude, Laura and Diane, we started exploring concepts for digital jewellery to support their sense of self in relation to the context of journeying home and being between two 'homes'. The conversations continued over a course of a year in a series of one-to-one meetings (3-4 meetings with each participant). During these meetings, I presented a new set of objects (*Thimbles, Music DIY kit, Compass for Ourselves, and Sea Pottery*) as stimuli for them to explore concepts inspired from their reflections. All the ideas where presented to all three participants to instigate further thinking on ideas on how their sense of self could be potentially supported through examples of digital jewellery. Section 4.8 presents these dialogues.

Section 4.9 presents the four pieces of digital jewellery made in this study (*Topoi, Togetherness: Anthos and Chronos Brooches, Microcosmos and Travelling with the Sea*). Within each sub-section, I start with the description of the piece, followed by detail of what inspired each of them and the design development stages. The insights (where the inspiration of these pieces is coming from) are described in greater detail in Section 5.3.4 (p.197).

4.1 Recruitment, Data Collection and Analysis

My principal concern in my recruitment of participants was firstly, the creation of opportunities for personal engagement in conversations about self and feelings of *being-in between* and secondly, the creation of opportunities for digital jewellery to support fluctuations and changes to one's sense of self during the journeys between two places of home. In this section I will detail my sampling method for recruiting participants and my analytic procedure in its multiple stages.

In the participatory phase of the research I worked closely with three design researchers, all are born in different places in the world, but who currently live and work in the UK and periodically travelled back to their home of origin for short breaks. Laura and Jude have background in product design, Diane in performance arts. When the research was conducted, they were are working within HCI and design research. Throughout the thesis, all participants are referred by fictional names.

I selected these participants firstly, because they had the experience of living in two different places and travelling between them and secondly, to enable a particular level of discourse around the potentials of digital technology in the conceptions of new forms of digital jewellery. The small number of participants was chosen in order to get to know each other and engage with them in personal dialogue over time. It was an opportunity that arose to work with them and they happened to be women. I approached Laura after meeting her in the beginning of my research and I found her interested in the context of the research. In her research work she looked at personal meaning associated with digital objects. Jude and Diane have worked in the past together and I had known their work. Jude had an interest in craft and digital making and Diane had an interest in artistic explorations of digital technology and performative ways of doing research in design. As such all three participants had experience in alternative uses of digital technology which could add richness to the development or potential of digital jewellery. I felt they all were open-minded to the idea of digital jewellery and that they would bring an interesting discourse around the context of the research.

Our participatory engagements lasted for a period of one and half year and throughout the study, Laura, Jude and Diane were encouraged to contribute to the research in ways that they felt *right* to them. I was attentive to what they felt

comfortable to share, sharing some of their values. Feelings related to the notion of home and belonging are personal, often implicit in nature, and not straightforward to share. I found useful the framing of dialogicality in design to open up a space for dialogue. I have detailed in previously how I felt the particular use of probes approach, the specificity of the plane and theatre methods to be valuable for this research. Throughout the research, our ideas and experiences of this context of transitions were in dialogue in order to foster anew understanding on the potential of digital jewellery for this context.

The first step to my process was to meet each of the participants in person, introduce my motivation and the creative and performative methods I was intended to use during the research. They were enthusiastic about the study and in the next meeting I gave them an invitation for the Air[craft] workshop, a document with the aims of the project and an informedness of consent, in which I detailed the research study and how I would use, store and disseminate material gathered within the research (see AppendixE).

Our first dialogical engagement was the Air[craft]. During the workshop, participants' reflections were documented in a journal and in their probes' responses. Deviating from the original concept of a cultural probe (Gaver et al., 2004), I invited participants into a follow-up interview to interpret their probe responses and express themselves through captured information (Mattelmäki, 2006). By doing so, I tried to record the diversity of their personal values and meanings associated with probe objects. This extra layer of participants' interpretation informed later my probe interpretation. I also noted down my own experiences and reflection soon after the workshop. All the material gathered (the journal, the probe responses, the transcript of the discussion, my reflections) were analysed in an open-ended way and with sensitivity to the data being shared. This openness helped me to start identifying themes that could inform ideas for the design of digital jewellery. These ideas were presented back to participants during one-to-one meetings as the research progressed. These meetings were recorded, transcribed and analysed with a view towards design outcomes. My thinking was continuously shaped and shared with the participants during these meetings, as we developed ideas further in dialogue. As my understanding developed, I revisited and updated my initial design framework which I used to start making the final digital jewellery pieces.

Participants started disengaging from the research after one year of our dialogical engagement. I continued contacting them (for 6 months) however, Jude

responded to my emails very irregularly and Diane's engagement diminish for personal reasons. This is the reason why I did not get back to them to get responses on the final designs. It was important for me, however, that Jude, Diane and Laura would feel that I had valued their insights to the research. For this reason, I have detailed the making of the pieces and were the inspiration came from.

It was important, however at that point in the research to find another way to triangulate my design outcomes in order to complete my research on the time given. In Section 3.7 I presented that in order to capture different dimensions of the same phenomenon, I used an adapted Delphi method prompting discussions on the values and characteristics of digital jewellery among a small group of experts in the field of digital jewellery more broadly. I detailed how the experts were selected in Section 3.7.1. I contacted the Delphi participants via email where I detailed the purpose of the study and the aim of my doctoral research more broadly. Participants were aware that they were engaged in data collection activity and an informedness of consent was included in the information email.

In this part of the research I followed a systematic analysis with analytical software (NVivo). The collated responses were coded sentence by sentence and then categorised into themes as they emerge from the data itself. In that way, I stayed close to the data and open-minded to what was being said about my designs. My aim was for a conceptualisation of emerging/underlying patterns that could inform the making and understanding of digital jewellery. The analysis was shared with the Delphi respondents in order to foster a collective understanding of the potential of digital jewellery.

4.2 Explorative Phase

In this first phase of the research, I was filled with a sense of curiosity and the energy to explore, both conceptually and physically, different combinations of materials and moving in diverse directions. Some examples from this phase of the research include; screen-printing with thermochromic inks (see Figure 4.2-1), learning crochet to incorporate electric wires and learning the basic of coding and making with electronics. Some explorations turned out to be more rewarding than others and guided the direction of the following try-outs accordingly.
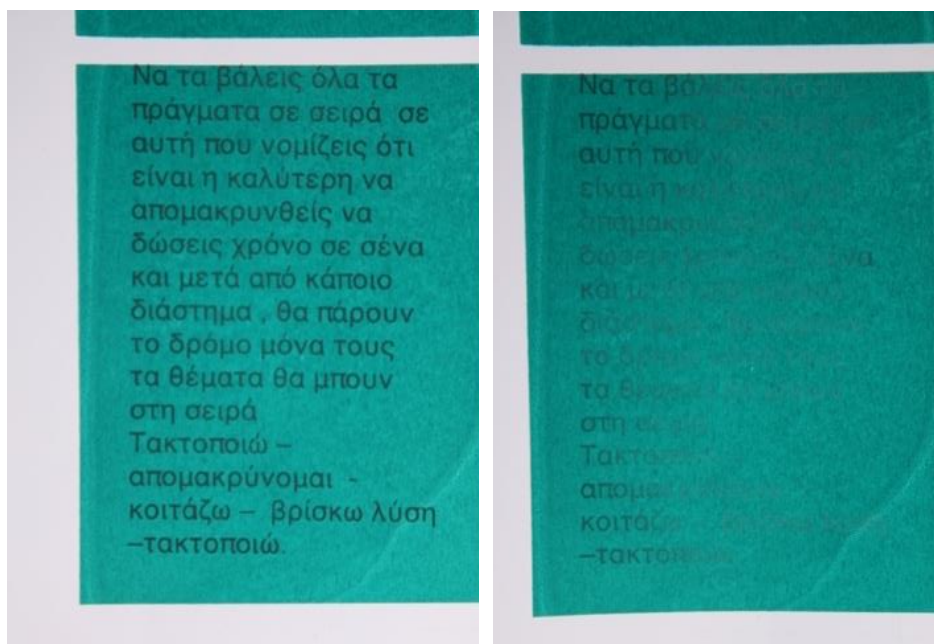
Figure 4.2-1 Exploring materials and transformations. Screen-printing with the thermochromic inks. The ink disappears when the temperature is over 27degrees. The process is reversible.

In my first explorations, I experimented with transformative materials that change their state through physical contact or environmental conditions such as temperature. I made a bracelet out of ice and another one out of wax and candle wick and I created a series of video that capture the pieces changing over time (see Figure 4.2-2 and Figure 4.2-3). This exploration was inspired by my master thesis work on physically augmented jewellery pieces and their meaning within a person's life.

Figure 4.2-2 Playing with *Ice*. Source: Screenshots from the Metamorphosis #01 video.

Through the making of these pieces of jewellery and the corresponding videos and design scenarios, I realised that the transformation of the piece only became meaningful to me when I envisioned that the object was connected to a significant other. In the *Ice* scenario, I imagined that the piece revealed the familiar smell of my grandmother whilst melting. The *Ice* piece changed slowly over time, as the temperature of the environment remained mostly stable.

In the *Wax* scenario I imagined that the piece is shared with another person. The wax piece changed its form in seconds. In the *Wax* piece, the result was unpredictable and for me this made the wax piece more interesting. This time difference made me realise that the process of transformation could be very interesting in itself, and not just the object's state before/after the transformation. These explorations informed my early thinking of how the transformation process could inform a new digital design for a piece of jewellery.

Figure 4.2-3. Playing with *Wax*. Screenshots from the Metamorphosis #02 video.

In the same way that I was exploring objects that changed their physical state over time, I also began exploring the way in which digital circuits might provide an opportunity to explore transformations. My exploration into the world of coding and physical computing gave me the opportunity to better understand the complexity of working with digital and wearable technology.

In the design process when working with electronics, I discovered that to achieve what I had envisioned in the concept and work was not within my reach. In order to understand electronics, I started to frame them as a material at various abstraction levels and work with simple prototypes by having some of the envisioned characteristics present, and some imagined. From early stages of my research, I engaged myself with experimental means in order to explore interactive contexts, such as video prototyping and placebo-probes. This approach gave me the space to test my ideas and discuss them with James Thomas, the creative technologist who was working at Northumbria University at the time.

4.3 Understanding the Context through Making

In order to better understand the materialities of digital jewellery, I started exploring the context of micro-transitions (see Section 2.6 p.44). I began this exploration into micro-transitions by looking at my own lived experience and making objects driven from my own experience of moving between the UK and Greece. This helped me reflect on certain situations that arose in my own experience. During this phase, I made two thought pieces *(Let it Go, p.92 and Hide and Seek, p.97),* and I ran a co-design activity with my mother (*Space for emotions, p.101*), which I will describe in the following sections.

4.3.1 Let it Go Piece
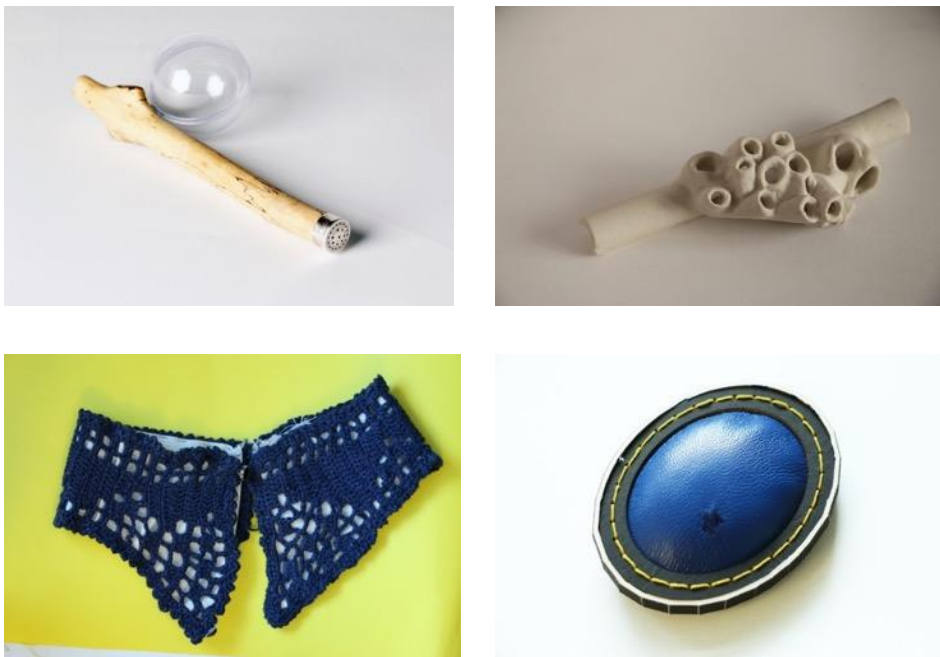
Figure 4.3-1 *Let it Go* piece by Nantia Koulidou, 2015.

The four prototypes. Top left. (P1) Found objects, plastic, sterling silver. Top right. (P2) Parin. Bottom left. (P3) Crochet yarn, fabric, electronics. Bottom Right (P4) Cardboard, leather, thread, electronics.

4.3.1.1 Description

Let it Go is a hand-held piece made out of a found tree twig, a plastic bubble and silver. The piece is a thought piece that acts as a vessel for my thoughts and feelings of transition by recording my narratives and reflections. The recordings stored within the piece cannot be accessed immediately, however, they are saved in the piece and can be accessed at later times.

4.3.1.2 Inspiration and Design Development

For the piece, I designed four prototypes (P1, P2, P3, P4), each with different forms and each suggesting a slightly different interaction. My thinking in creating these prototypes was that by externalising my thoughts, I would potentially become more aware of how I was feeling in the moment and thus, feel more comfortable with the change.

The First Prototype (P1)

Figure 4.3-2 *Let it Go* piece (P1). Screenshots from a video prototyping.

P1 (see Figure 4.3-2) is made of a found twig, a detail from silver that reminds us of a microphone and a plastic bubble. When I talk in close proximity to the piece, the responds to my voice by filling in with water. When the vessel (the plastic bubble) is full of water, I had to pour the water manually out of the vessel and start all over again. This was designed as a symbolic action representing the idea of emptying my feelings and thoughts.

In order to explore the interactive qualities of the piece, I made an explorative video that imagined myself using the piece before my next journey. In my reflections-in-action, I recorded that I found it challenging to talk to an object, however I enjoyed the way that the piece responded to my thoughts (by filling up with water). This interaction helped me imagine that my feelings and frustrations were now externalised and "outside me" (being stored inside an object) making me feel relaxed and relieved.

The Second Prototype (P2)

Figure 4.3-3 *Let it Go* piece (P2). The Design development of the second prototype in collaboration with Sean Kinsley. Left to right: a) Working with clay and copper to find the form of the piece b) Prototypes c) The final prototype made of parian porcelain.

The second prototype (see Figure 4.3-3) was developed through conversation with other practitioners in Duncan of Jordanstone College of Art & Design (see Appendix A p.247). During my visit, I spent time at the ceramics workshop with Sean Kinsley, the head of the ceramics workshop. I brought a poster with me that communicated the idea around the first prototype and I explained to Sean that my aim was to simply experiment with clay and see what happens. Figure 4.3-3 shows some of the prototypes.

The final prototype (P2) is made of parian porcelain (Figure 4.3-3c) and has the form of a sea shell. The translucency of this type of porcelain allowed me to think that the piece could respond to my voice by filling up with light.

From that point on in the research, I started thinking of ways that I could functionally make pieces in order to explore the interaction in practice and test

parts of the concept. This was based on the realisation that it would be difficult for me to make a working prototype with working voice recognition functionality that would respond to a voice with water or light. This ability was beyond my prototyping abilities at this stage of the research.

The Third Prototype (P3)

Figure 4.3-4 *Let it Go* piece (P3). The design development of the third prototype.

P3 (see Figure 4.3-4) is made of a handmade crochet lace collar with a pre-produced 10s recording device (stitched at the back of the piece). The electronic component comes with two buttons; one for recording and the other for listening back. For this prototype, I only used the recording function of the component which was activated by pressing the button on the left side of the piece (stitched under the lace). I used crochet because it is an activity that I associate with my mother and it connects me with her. I remember her crocheting since my memories begin. During the explorative phase of the research, I learned to crochet myself in order to connect with my mum through making.

The Fourth Prototype (P4)

For the fourth prototype, I focused my exploration on how the function of the piece could inform the form of the piece. My goal was to integrate the form of the prototype with the function of the prototype in a wearable piece of jewellery. The electronic element of the piece is simply a push button, which I wanted to manifest in the form of the piece itself.
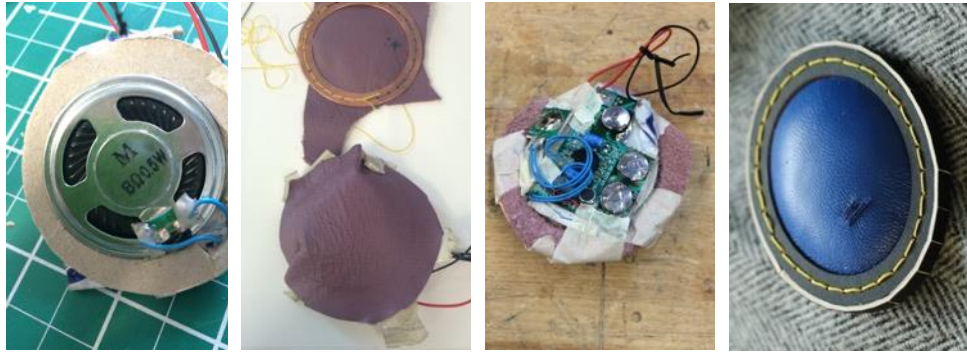
Figure 4.3-5 *Let it Go* piece (P4). The design development of the fourth prototype.

Figure 4.3-5 shows the making of this prototype and the electronic enclosed within the piece. First, I made a "button" from copper, leather and thread. In another iteration of the prototype, I used cardboard, leather and thread. I chose to work with high density cardboard instead of copper because it gave me the flexibility to play with the form and dimensions of the piece in a quick-and-dirty way. This was important in the process as I needed to make a number of test pieces in order to find a form that would house the electronics within the piece.

4.3.1.3 In-situ Reflections
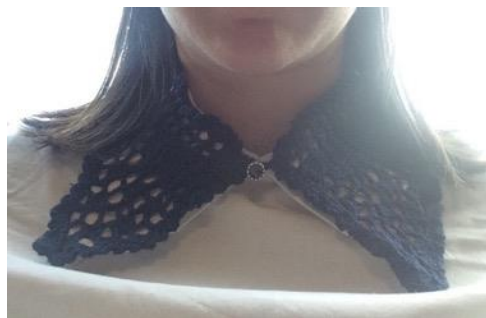
Figure 4.3-6 Wearing the *Let it Go* piece (P3) on my journey from UK to Greece

In testing this prototype on a trip to Greece I was able to capture some personal reflections during my journey. I liked the feeling of the piece on my body, however I found it very difficult to externalise my feelings in the airport or on the plane. Using the prototype was an atypical interaction with technology in the context of

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an airport so I felt self-conscious recording using the device. I think it was difficult because I recorded some messages in the toilets and some in the waiting rooms by pretending I was on my phone, which was an unpleasant experience.

I recorded a number of messages, however I realised soon afterwards that I had forgotten them all. With the practicalities of travelling, I did not have the time to relax and be in the moment. On the journey back from Greece to the UK, I asked my mother to record a message instead. Symbolically wearing her message made me feel comfortable on my seat while it accompanied me through my journey. Even though I did not know her message, just wearing it gave me a feeling of reassurance.

4.3.2 Hide and Seek Piece

Figure 4.3-7 *Hide and Seek* Piece by Nantia Koulidou, 2015. Paper, steel, brass. 7x4x0.5cm.

Figure 4.3-8 *Hide and Seek* Piece. The text slowly disappears as the temperature rises over 27°C. The picture was taken in Greece during the summer.

4.3.2.1 Description

Hide and Seek (see Figure 4.3-7) is a brooch made of a cover of A5 paper and a brooch pin made of steel and brass. The green cover has Greek text screen-printed onto the paper using black thermochromic ink. Parts of the text are visible and parts of the text are concealed by the folds around the brooch pin. If the temperature raises over 31°C, the ink becomes transparent and the text disappears temporarily (see Figure 4.3-8). This is possible because the ink reacts to changes in temperature. I imagined that in Greece, where the temperature often exceeds 31°C, the text would disappear and when travelling back to the UK, the temperature would decrease, and the text would appear.

The actual text that was printed on the paper was received during the *Space for Emotions* explorations (see more p.101) and it is a potent text that stirs motivation and connects me with my mother. The text translates as *"Find an order for things in your life - in the order you think is the best for you in the moment. Take a step back, give yourself time and after a while, things will find their place. Find an order - step away - observe - find a solution - things will order themselves"*.

4.3.2.2 Inspiration and Design Development

The inspiration for the piece came from the dramatic difference in temperature between Greece and the UK during the summer (which is a period of the year that I often visit home). The temperature in Greece is around 35-40°C in summer whereas in Newcastle it is around 15-20°C. In order to make a piece that reveals information at different times, I experimented with thermochromic inks that change colour above a specific temperature. The process was very explorative and I used a range of inks with different activation points. I was looking for ways that different parts of the collages I created could be revealed temporarily at different temperatures. Figure 4.3-9 shows one of these explorations: the blue is activated at 15°C and the black 31°C (text and rectangles). The sketch on this prototype was screen-printed on the fabric with conventional ink and another layer was screen-printed using black acrylic pigment.
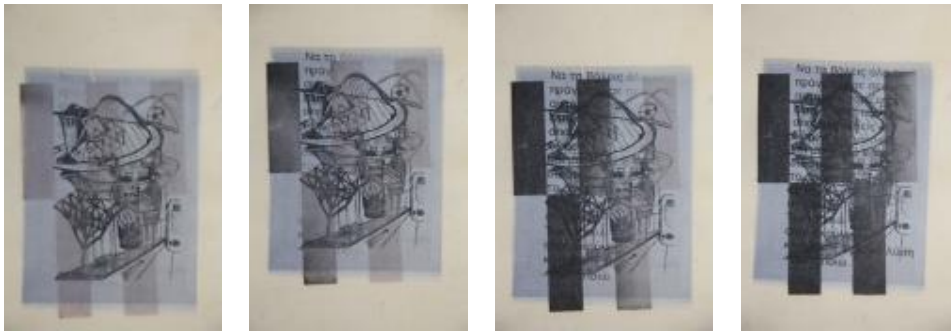
Figure 4.3-9 Explorations with thermochromic inks

One finding from this experimentation was that the thermochromic inks (TC) were pale and translucent and it was hard to achieve the desired layers of opaque colours. The TC layers blended together and instead of hiding information, the information was still legible. Simply by rubbing the TC Black (31 & 27) it would change to light grey. Ironing the TC Red (47) changed the red to light pink.

In this phase of prototyping, I experimented with different surfaces (paper, cotton textile, plastic-like textiles) and their effect on the TCs' transparency. I noticed that printing the TC on top of a solid layer of a pigment made the colour more solid and the text was not visible once the surface was over a certain temperature. This finding informed the design of the *Hide and Seek* piece.

4.3.2.3 In-situ Reflections

> *"I am at CPH airport in Copenhagen waiting for my next flight to UK. I am already half a day away from home and I have a mixture of feelings. I found a quiet space next to a glass window. I decided to wear the brooch."* [personal reflections].

Whilst sitting on the plane, I realised that the ink was sensitive to the environment of the plane. Before the take-off, the temperature was high enough for the text to disappear (see Figure 4.3-10). I enjoyed the playfulness of the changing state of the brooch by touching the piece often. In doing so, I could reveal different parts of the text at different time. The plane's environment and my body were in dialogue with the piece and this dynamic relationship made me think about the significance of the text in my life. After the take-off, the text remained visible for the rest of the flight and disappeared again when I landed in Greece. The piece was in dialogue with the environment and myself during the journey itself, with the text phasing in an out. This made me realise the significance of the plane as a space for design interactions. I will turn to this point in later stages of the research when I talk about the piece *Microcosmos* and *Travelling with the Sea* (See more about the pieces on p.149).

Figure 4.3-10 Wearing the *Hide and Seek* piece during a flight from Copenhagen to Newcastle.

4.3.3 Space for Emotions
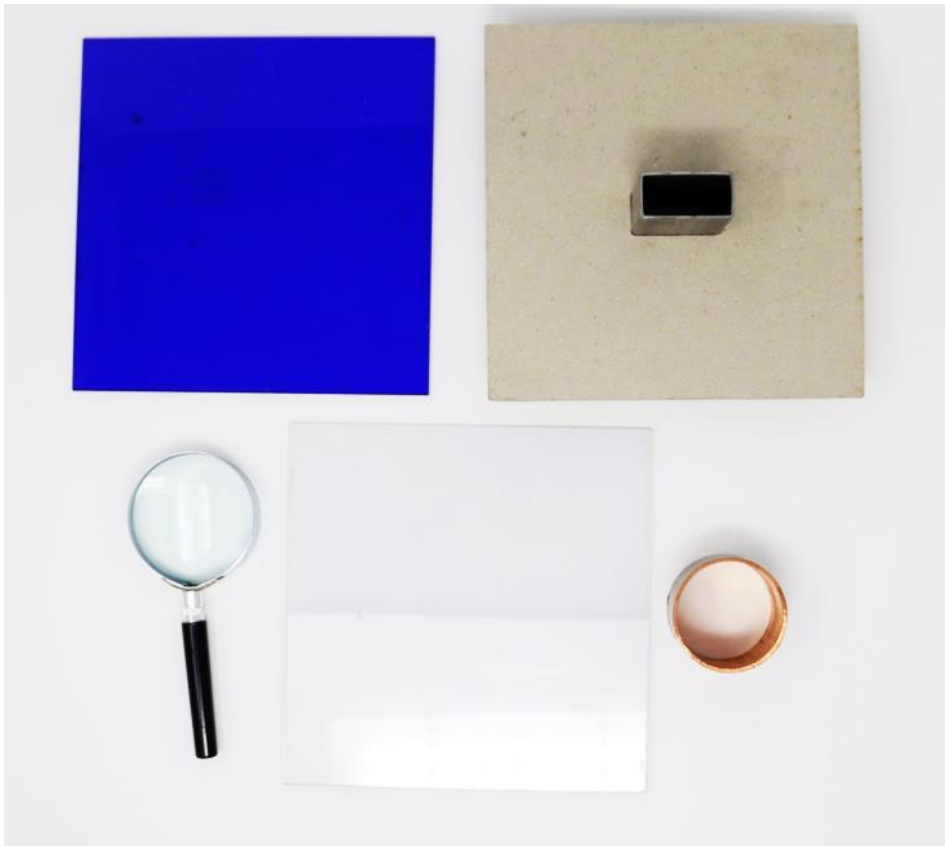
Figure 4.3-11 *Space for emotions*. Some of the objects inside the design probe kit. From top left: Blue plexiglass sheet 10x10x3cm, cardboard sheet 10x10x3cm with a rectangular tube 3x1x5cm. From bottom left: a magnifying glass, transparent/translucent plexiglass sheet 10x10x3cm, a copper cylinder diameter 3cm.

4.3.3.1 Description

Space for Emotions was a design probe kit developed specifically for my mother. The kit facilitated an activity between us that took place over a period of two months. The aim of the probe was to explore ways of emotional connectivity between myself and my mother through media other than words. The package of probes, sent to my mother via the post, included:

- cardboard frames to act as a focus;

- a number of colourful lenses to change the colours within the space;

- a copper cylinder to create a focusing lens;

- a magnifying glass;

- a camera.

4.3.3.2 Inspiration and Design Development

By using a series of probes as an initial trigger (see Figure 4.3-11), I was able to begin a conversation through pictures and short stories based on the pictures. Pictures were exchanged via email approximately once a week. The pictures my mother shared were small details of a shared space in my home in Greece, and I shared similar details from my house in the UK. I asked my mother to take pictures of the different details of the room and write a few words for each picture. I was sending back pictures and details from my room in the UK (alongside a supporting narrative to my mother) in response to the pictures I received. The probe kit and the way my mother had to respond to the kit made both of us respond to each other in a creative way.

Following on from the conversations that took place as part of the design probes, I screen-printed some of the of my mother's pictures. By doing this, I was able compare the details of my childhood room with my house in the UK. My mother, on her side, started creating narratives to encourage me by using pictures of my childhood alongside a corresponding story.

Apart from the fact that we are both using our creative practice, we found ways of connecting with each other and share feelings and emotions. The details that we both focused on were things that linked us. Figure 4.3-12 shows an example of how we both started responding creatively to the material we were receiving. In one of the initial photos sent by my mother of my room in Greece, I spotted her slippers under my desk. My response to this photo was to screen-print and enlarge this detail. In these photos I started to encounter static reminders of home that I did not feel connected with. Over the years whilst I was still living in Greece I changed the colour of the walls regularly and this was an important detail that I wanted to add to the photos. In order to achieve this detail, I started to screen-print sections of the photos that were being sent to me and I sent these images back to my mother. The floor tiles were another detail; however, these remain unchanged and became an anchor in the prints.
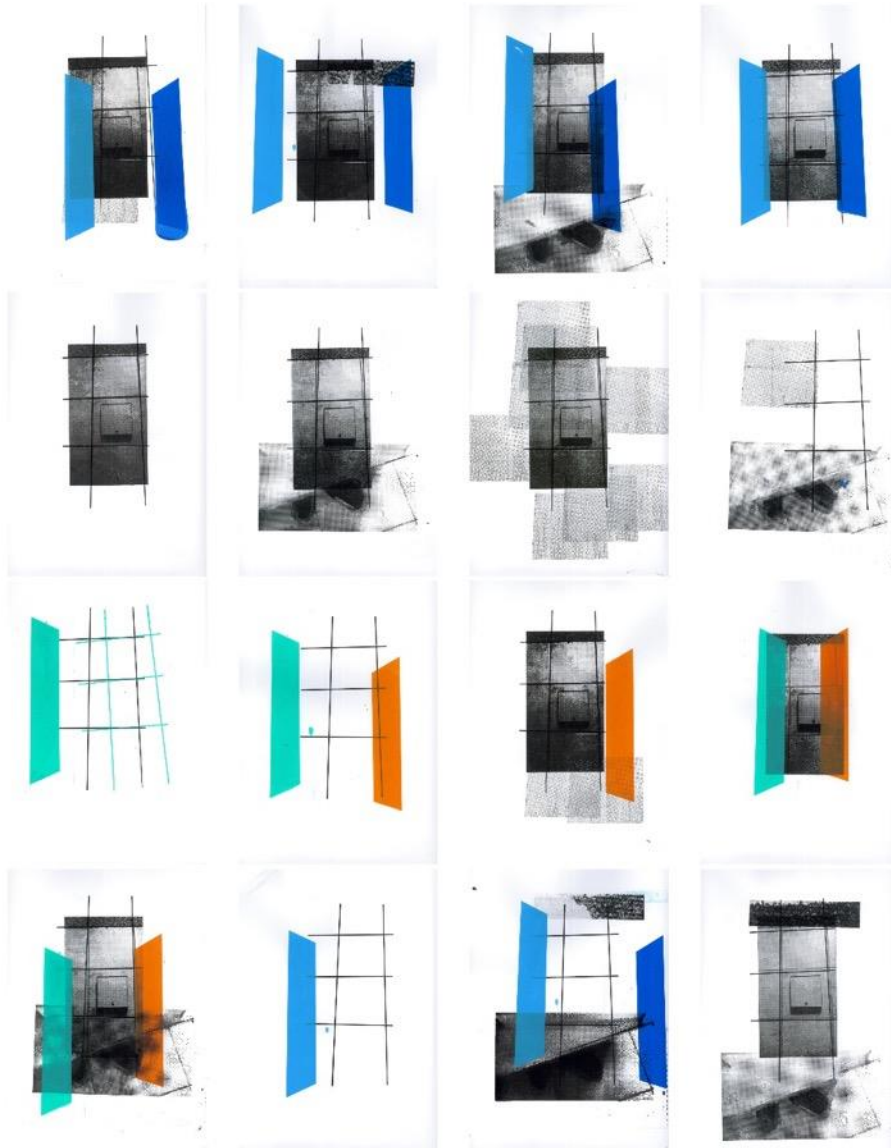
Figure 4.3-12 My creative responses to the material I received from my mother. I enlarged details of the pictures and I screen-printed section of the photos being sent. Through this process, I was reflecting on my room, my relationship with my mother and myself.

In the next set of responses my mum looked through the blue lens (a part of the probe kit) and took photo of picture from my childhood (see Figure 4.3-13). She commented that no matter how much the lens distorted the image she could still see my facial expression. This, in turn, inspired me to take a picture of a photograph of her in Rome; a photo that I always have with me. I turned the image into a black silhouette and I was surprised that I could still see her likeness in the picture.

Figure 4.3-13 (left) My mother is taking a picture of a photo from my childhood through the blue lens. (right) My response to her creative act was to overexpose a picture of her in Rome that I always carry with me.

The *Space for Emotions*, in general, opened up a space for me to think of ways of sharing feelings and thoughts in a creative and visual ways rather than by being a typical written and language-based dialogue often found in research. Considering the dynamics of this type of communication between myself and the participants in the study is an important element of my research into digital jewellery. In Section 4.7, I will talk in more detail about how I used sketching as a way to form a visual dialogue with the participants about their sense of self.

4.3.4 My Personal North Piece

Figure 4.3-14 *My Personal North* piece, by Nantia Koulidou, 2016. Wood, leather, paint, plexiglass acrylic and electronic components. 10cmx10cmx8cm.

4.3.4.1 Description

The *My Person North* piece is an interactive object that is anchored to a place that is significant to a person based on specific GPS coordination. The object is made of wood, leather, paint, plexiglass acrylic and electronic components. The image on the plexiglass is the picture of the sky from the place where the needle is anchored; for this prototype it is an image from my home in Greece. Within the piece are enclosed a digital compass, a GPS module, a driver for the motor and a stepper motor.

When the object is connected to the power, the needle calibrates for a few seconds, slowly redirecting itself to a specific location. Once the needle is calibrated, it behaves like a compass and it always points to the chosen direction (see Figure 4.3-15). Compared to a compass which is used for navigation and orientation (always showing a direction relative to the magnetic north), the piece is anchored to a personal point. The idea is a proof of concept that has not been developed further due to challenges with the making process as well as the time

limit available to complete this research. I will turn to this point in the Discussion (Chapter 5 in Section 5.2).
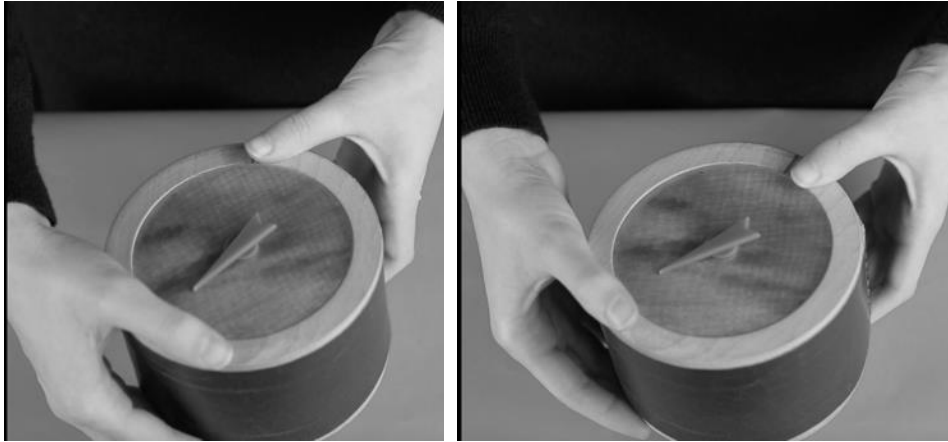
Figure 4.3-15 *My Personal North* piece is anchored to a specific location. Screenshots from video.

4.3.4.2 Inspiration and Design Development

The idea of the piece was inspired by my conversation with the private airplane pilot (see p.123) regarding a compass that always points home. For the making of the piece, I wanted to develop a prototype in small scale. My initial idea was to use a small motor to behave like a compass. Tommy (the creative technologist who was helping me in this phase of the research) suggested using a servo motor that could allow us to control the position of the motor precisely. In our attempt to make the motor respond like a compass, we were testing the interaction with a magnet (when you bring a magnet close to a compass, the needle points towards the magnet). In the next phase of the prototype, we tried a tiny stepper motor instead, however the interaction was very erratic and not under our own control. In the end we used a stepper motor (43.2 x 43.2mm) and we managed to achieve a more desirable and fluid interaction, however the scale of the prototype was much bigger than was desirable.

When we stopped developing the prototype further, Jayne and Neil (my supervisors) helped to make a box that could host the electronics. Neil made the wooden parts and Jayne gave me the leather piece, which was scrap from another project. I mentioned earlier that the screen-printed image of the sky on plexiglass was from my favourite place near my parents' house in Greece. The combination of

the materials and the form of the piece overall did not have the sensitivities that I wanted. This process helped me to realise that it is important to work together on the aesthetics of interaction and the aesthetics of the piece. This was a learning curve for me. I applied this thinking to the making of my digital jewellery pieces
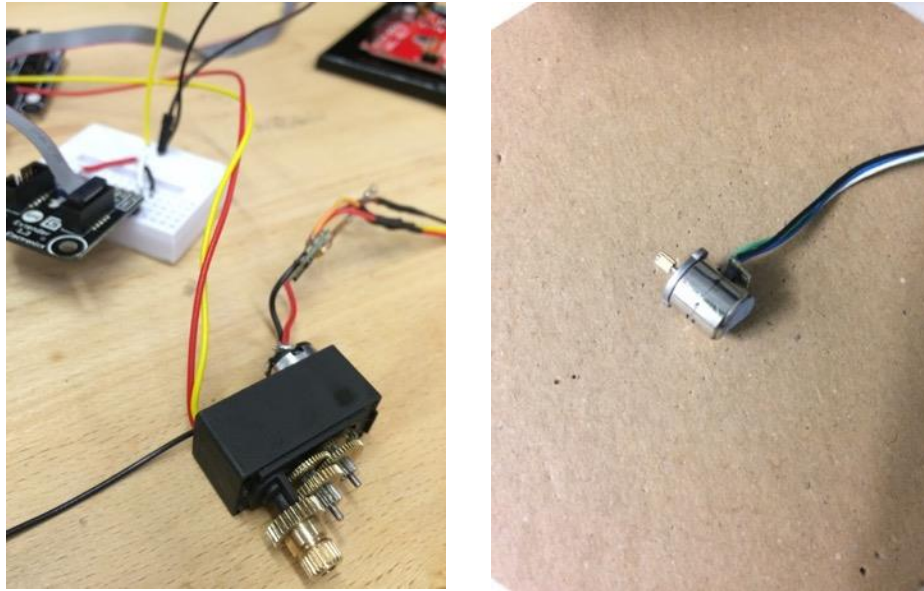
Figure 4.3-16 Design Development of the My Personal North piece in collaboration with Tommy Dylan. (left)The Gadgeteer mainboard with a compass module and Servo Motor. (right)Working with a tiny Stepper Motor.
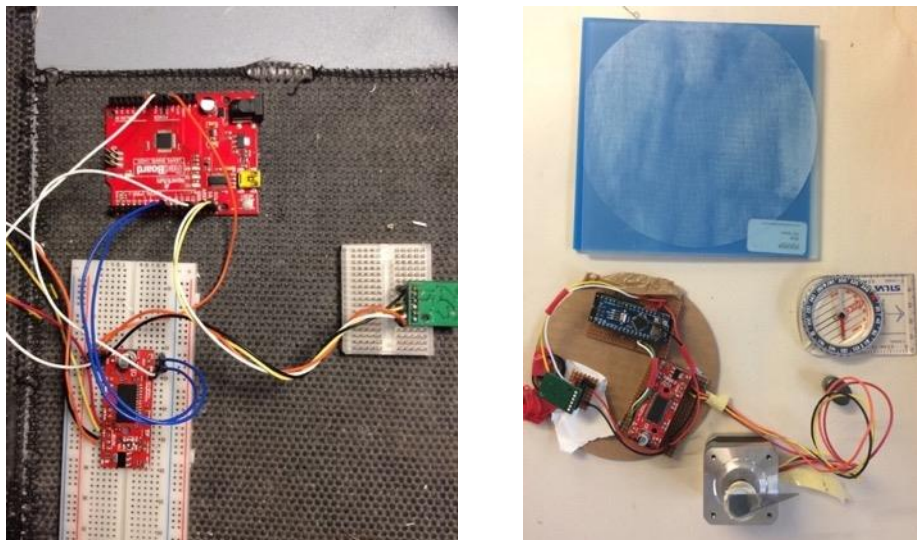
Figure 4.3-17 left. Working with SparkFun RedBoard, a digital compass module, a stepper motor (43.2 x 43.2mm) and a stepper motor driver. right. Replacing the SparkFun RedBoard with an Arduino Nano.

4.4 Initial Meeting with Participants

An initial meeting, pre-*Air[craft] workshop* with each participant (Diane, Jude and Laura) gave me insights into their lives and helped to create a space for dialogue. During the meeting, I introduced them to the research and the theatricality of experience they could be part of by giving them the invitation in the form of a flight ticket (see Figure 4.4-1). The participants were asked to prepare their luggage for travelling which in this case meant bring artefacts that would usually accompany them during an aeroplane journey and artefacts that they relate with home. Insights from the first meetings became inspiration for the design of bespoke probes centred on sense of self, expectations of travelling and home. Each participant shared with me aspects of their lives that they did not want to explore in this research, which I carefully considered when I designed the probes for the *Air[craft]workshop*.

Figure 4.4-1 Participants' ticket for the *Air[craft] workshop* at Newcastle Aviation Academy near the Newcastle International Airport, Newcastle upon Tyne.

4.5 The Air[craft] Workshop

The *Air[craft] workshop* was an experiential workshop which took place on a stationary plane at an airport and a discussion (following the plane experience) that took place in the airport terminal building. The workshop was set in a functioning (yet stationary plane) at the Aviation Academy in Newcastle, adjacent to Newcastle airport, UK. The *Air[craft] workshop* was centred around a performance in which I

acted as a flight attendant throughout the workshop. A series of six design probes were given to the participants for completion during the 2-hour workshop in order to stimulate their reflections when journeying back to their country of origin.

The theatre of the workshop was created using the onboard PA system to deliver flight attendant announcements; something that invited the three participants to explore the probe objects in relation to the artefacts they brought with them and their feeling and emotions of being in-between. This involved turning on the aeroplane engines to create the sound of being in-flight, using the flight attendants' trolley to pass between the participants at intervals to give them probes to respond to and by having a set trajectory of take-off, in flight and landing periods. During the workshop the participants documented their thoughts and reflections in a Travel Journal (see Figure 4.5-6). The workshop was documented by taking pictures and short videos.

Figure 4.5-1 In my role as a flight assistant during the *Air[craft] workshop*.

Figure 4.5-2 The setting for the *Air [craft] workshop*. The interior of the plane. At Aviation Academy, Newcastle.

Figure 4.5-3 Diane' design probes. The design probes were given to the participants during their time on the airplane for completion during the 2-hour workshop. Under the table is Diane's suitcase (as part of the theatrical aspect of the workshop).

Figure 4.5-4 During the *Air[craft] workshop*. Laura is interacting with one of the design probes.

Figure 4.5-5 During the *Air[craft] workshop*. Jude is interacting with one of the design probes. Jude brought with her knitting needs and yarn.
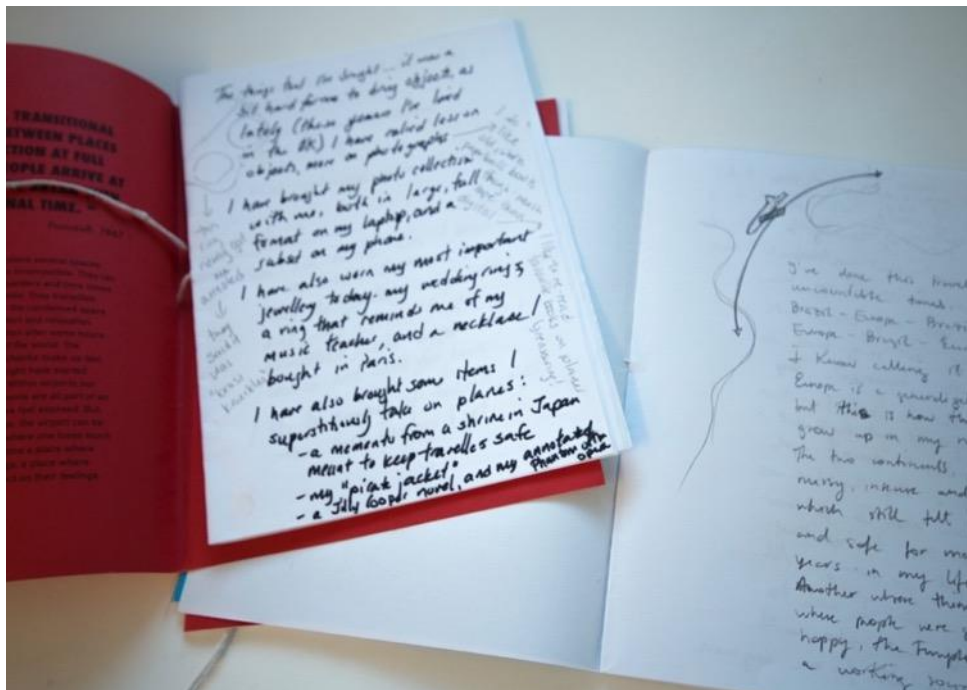
Figure 4.5-6 Travel journal. Participants' reflections during the *Air[craft] workshop*.

4.5.1 Design Probes and Discussion at the Airport

A series of six design probes (*Comfort me, Chew of familiarity, Neither Here nor There, Parts of Me, Parts of Me and You, Untitled pieces*) were given to the participants during this event for completion on the plane. The probes were aimed at understanding how the participants felt when journeying back to their country of origin – and then returning to the UK. That pushed me to create methods for this particular context and that were bespoke for the participants. The objects offered alternative ways for the participants to reflect on their experience of transition and how this affected their sense of who they are, as well as to trigger their imaginative thinking on ways to support the transition in an emotional and personal way through examples of digital jewellery. In the following section, I will describe each probe separately and present the theatricality of the workshop. To help describe the theatricality of the workshop, I will include the announcements made during the workshop.

(announcement)

> *Welcome on-board Flight 4U2377 with service home. My name is Nantia Koulidou and I will be your flight assistant for this journey. Laura, Jude, Diane please feel comfortable on your seat, get the things that usually accompany you in the flight. Please, secure all your precious belongings underneath your seat or in the overhead compartments. You know you are on your way home. When you feel ready, please fasten your seat belts and switch off all your electronic devices. In front of your seats we will find a travel journal, some pens and an audio recorder. During the flight use the materials to capture your thoughts and feelings. Please feel comfortable on your seat and get the things that usually accompany you in the flight and things that link you with home.*
>
> *Take a minute and have a look on the space in case you feel you need to visit it during the flight. During the flight information will be provided down from above your seat, below your seats and I will guide you through the different activities. The journey will take approximately two hours. We will have a short break for refreshments and then we will have a discussion all together at the airport.*

4.5.1.1 Comfort me Probe

Figure 4.5-7 *Comfort Me* probe (included sleeping mask, earplugs and a neck cushion). Fabric, thread, plastic, foam.

The *Comfort Me* (see Figure 4.5-7) was the first probe given to participants and contained a sleeping mask, comfort cushion and earplugs, which are conventional objects used in the flight to provide comfort. Participants were invited to focus on their bodily experiences and listen to their bodies through paying more focused and intensive attention to what is happening to their bodies by listening to their senses. Questions were embroidered onto each of the probe pieces to encourage participants to think about the feeling of being in-between and their bodily presence. *Where do you find your comfort? What makes you feel best in your journey home? How do you feel in transition? Where is the tension in your body?*

(announcement)

> *Give yourself some time hold your breath for a few seconds. Close your eyes, your ears, and focus on different parts of your body. Spend a few minutes to navigate around/ scan your body and think about how you feel in this situation. You know how it feels to travel home. You have experienced it before. If it helps, can give a name to this feeling. If it is a specific part of your body you can point on that part and bring the focus there. What are the different sounds, places, things, people that link you with home? Nobody can hear what you say. You can whisper your thoughts*

in your audio recorder. I know that you might experience some bodily changes due to the environmental condition, the physicality of being in the air and seating in a confined space. Some of you might be afraid of flights. In this journey, I want to invite you to focus on how you feel when you are moving from one country to home. Think of home…We are ready to take off.

4.5.1.2 Chew of Familiarity Probe

Figure 4.5-8 The *Chew of Familiarity* probe. Paper, brass, stainless steel, sweets.

The *Chew of Familiarity* (see Figure 4.5-8) is a jewellery-like probe that invited participants to chew a piece of gum and focus on their senses; the sense of smell, taste and feelings or physical places that have a significant meaning to them. The piece was made of paper, steel and brass and could be worn as a brooch. The form of the piece was inspired by the *Hide and Seek* piece (see p.97). Participants were engaged in a reflective practice as they thought of home and the artefact in relation to their body.

(announcement)

> *Where are all the feelings of home? Chew the gum of familiarity and tell me what are the smells and tastes that links you with home. Write them down in this piece of paper and fold it back.*

4.5.2 Parts of Me Probe

Figure 4.5-9 (left) Initial sketch for Diane after the first meeting. (right) The *Parts of Me probe* for Diane. Fabric, thermochromic inks, embroidery hoop.

Parts of Me has a generic form, with a fabric that I made bespoke for each participant; a different sketch was made for each participant and placed in an embroidery hoop. The sketches featured a female figure at the centre representing the participant and divided the self into work (right of the figure) and home of origin (left of the figure). Figure 4.5-9 shows the initial sketch for Diane and the bespoke probe. Each image was inspired by my first meeting with the participants where they shared with me about things about their lives. My aim was not to try to communicate findings or ideas, rather it was to present a sketch concerning personal aspects of transitions as the start of a visual conversation with each woman. The sketch was covered with a layer of thermochromic ink that occluded the drawing at normal temperatures, but which once heated up over 27degrees (i.e. by using the warmth of the hand) disappeared to reveal the sketch. This interaction was reversible (see Figure 4.5-10).The probes were shared with the participants and in a short time, they were asked to identify aspects of their personal stories in the sketches.

(announcement)

The piece is a bespoke piece. It is inspired from your descriptions on transitions and notions of home. Rub the piece with your fingers and reveal something about you.

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Figure 4.5-10 Laura's interactions with the *Parts of Me* probe during the *Air[craft]*
workshop.

4.5.2.1 Parts of Me and You Probe

Figure 4.5-11 (left) *Parts of Me and You* probe. (right) Jude's sketched responses during
the *Air[craft] workshop*

Parts of Me and You was a piece that was a continuation on the *Parts of Me*
probe. *Parts of Me and You* acted as a reflexive tool for participants to see

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themselves in an abstract, visual way and continue the sketch with similar visual language. Each participant was given a sketch-based probe (see Figure 4.5-11) comprising of an A1 sheet of paper with the sketch composition that had been drawn for each woman in the centre of the page. The initial sketches captured notions of self from my perspective. The participants were asked to draw things that they thought were not represented in the sketches and that they felt were missing. In essence, I asked them to add other elements of who they were and how they felt in relation to two different countries. I chose sketching because it offered the space for visual dialogue with multiple interpretations (see section 3.3.3 for further discussion of sketching as a method in this research). Figure 4.5-11 (right) shows Jude's sketched response and Figure 4.5-12 shows the sketch after being traced a different piece of paper.

Figure 4.5-12 Jude's sketched response to the *Parts of Me and You* probe. Using a pencil and tracing paper I traced the picture that she had shared with me.

4.5.2.2 Neither Here nor There Probe

Figure 4.5-13 The *Neither Here nor There* probe. Copper, clock mechanism, plywood, paper, polarising filters. (right) Laura placed her ticket into the slot in the side of the piece. The question is slowly revealed.

The *Neither Here nor There* (see Figure 4.5-13) explored the temporal and spatial dimensions of the transition; when does the transitional period start and end and what does this mean for the participants' sense of self. The piece invites participants to engage in a reflective practice of being in-between. The question "*When does the transition start and where does it end?*" was slowly revealed to the participants when they placed the flight ticket (given to them in advance see Figure 4.4-1) into a slot in the side of the piece. The ticket activated a clock mechanism that was hidden inside the piece. The object utilised polarising filters to hide and reveal the question.

4.5.2.3 Unknown Pieces

(announcement)

> *We are above the clouds. Here anything is possible. Let yourselves free to imagine how a piece of jewellery can support your transition. Think about the different dynamics you experience; family, place, friends, things. You shift from friends, stories, things to different narratives. Open the suitcase with materials that are important for you and support you during transitions. Go back to all your thoughts, objects you interacted with today. What is this space in-between? What is it like, feels like?*

Figure 4.5-14 *Unknown 01* Probe
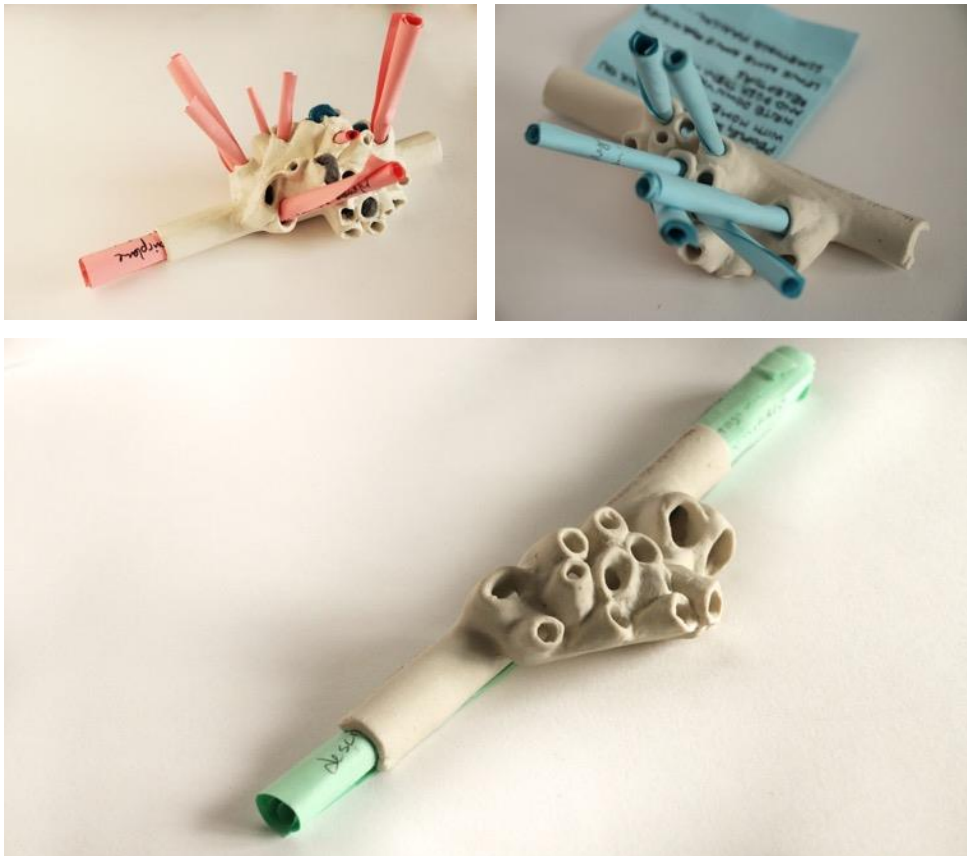
Figure 4.5-15 Ceramic *Unknown 02* Probe. Participants' responses (top left) Jude's piece (top right) Laura's piece (bottom) Diane's piece.

In the last part of the workshop I invited participants to start thinking and exploring ways that objects could potentially support the experience of being in transition. The *Unknown* probes were made during the explorative phase of the research (see Section 4.3.1 p.92). In this part of the research, I used the objects for two reasons. One reason was because I wanted to share aspects of myself with the participants in the form of a dialogue through objects (see p.58) and the other reason was that the forms of the objects themselves offered an odd combination of materials and shapes that reminded me of surrealistic techniques that have been used for elevating the unconscious and provoking new dialogues, such as dream writing and the game of chance (Boehner et al., 2012). In my methodology, I outlined that estrangement is another quality of probes that has been useful in this research to provoke imaginative thinking of new technologies (see p.60).

For the workshop, I took advantage of the physicality of the objects and invited participants to explore design possibilities. I introduce them as two surreal objects that the participant was asked to name and to think of its function. For the *Unknown 01* the participants were asked to *Whisper a thought* and for the ceramic *Unknown 02* to hide in the little receptors feelings of home and leave some space for their wishes. The following text was written on the *Unknown 02* piece: *How does this surreal object can accompany you in transition? Give it a name and make your own story*. Figure 4.5-15 shows participants' creative responses to the probe.

(announcement)

> *We are soon approaching home. We are preparing for landing. Look outside the window. The local time is 5pm and the temperature is 10degrees. Please check all your personal belongings and let's meet at the airport to have a nice discussion about this experience. Discussion at the airport.*

Following the 'flight' the participants were interviewed as a group about the experience and in order to reveal their additional reflections about the micro-transitions one experiences when travelling between two places/countries (each perceived in some sense by them as 'home'). The probes were placed on the table at the café at the airport and we talked through the various experiential and performative qualities of the workshop, the actual location and ways to continue our dialogue over time (see Figure 4.5-16). Insights from our conversation are presented in Chapter 5 (Section 5.3.4 p. 197).

Figure 4.5-16 Photos taken during the discussion at the airport. Participants are discussing the ceramics *Unknown 02* probe.

4.6 Dialogue with Externals in Aviation

In total, I had three separate interviews with pilots and professionals throughout the course of my PhD research. During a trip on a commercial airplane I spent a short amount of time interviewing a pilot in the cockpit in relation to a prototype that I was designing at the time. In addition, I had a conversation with the creative director working for a British airline about my research and new ideas in passenger's experiences. Finally, I had a conversation with a pilot in relation to the design of digital jewellery.

4.6.1 Commercial Airplane Pilot

After landing on a flight from the UK to Greece I took the opportunity to talk to a pilot of a well-known commercial airline who flies Boeing 737s. For the design of one of the final digital jewellery pieces (see p.171). I needed to understand how cabin pressurisation worked on airlines so that I could set the parameters for the barometric sensor in the piece.

I learned that during the airplane taking-off the cabin is pre-pressurised at a rate of 100feet/minute (which is equivalent to 30m below the sea level, a very high

pressure compared to our normal atmosphere) to avoid discomfort for passengers and the crew. During take-off the cabin is gradually pressurised during the climb phase until the plane reaches its cruising altitude. At typical cruising altitude is in the range of 11 000–12 200 m (or 36 000–40 000 feet). At this altitude, 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 approximately 1.6-2.4 atm. These notes were useful for designing digital jewellery using barometers as sensors that altered a user's experience of a piece whilst at altitude (see Section 4.9.4.3 for a specific description of this aspect of the jewellery piece).

4.6.2 Creative Director working for a British airline

During our meeting I had the opportunity to discuss my ideas on digital jewellery pieces that function on a plane that offered opportunities for people to connect with what is meaningful to them from the home locations. During this meeting, the creative director suggested alternative opportunities to connect people with the unique experience of flying.

An idea that developed my thinking on digital jewellery was one of the airline's projects that was in a 'pilot/beta phase', which made data available to passengers from locations that a plane is flying over. The data was linked to the location of the geographical areas of endangered species in the sea. One could view these locations through a smart phone under the "sustainable mode" (in the settings menu) during the flight. This conceptual thinking made me consider geo-location data available from where a plane is flying over as being a type of connectivity with data that can be meaningful to the person during the transition. I considered that the data could be very specific to a person's life or a significant other who has travelled to these places, or it could link to a much wider database, like the airline's idea to connect with animal data. This idea was shared with the participants in a later meeting.

4.6.3 Private Airplane Pilot

During a flight from Athens to London, I was fortunate to be seated next a private airplane pilot. I discussed the nature of my research and my research questions which sparked the interest of the pilot. This opened up a conversation to

explore some of the issues relating to flights from the perspective of a private pilot.

Our discussion was centred on the ideas of digital jewellery pieces I was currently exploring. The pilot highlighted that there are very specific air space boundaries of countries, and that countries' flight tracking systems extend beyond the countries' physical boundaries. The pilot showed me the radar zone mapping on his tablet and shared with me that the airspace boundaries of the countries are almost on the borders of the countries (see Figure 4.6-1). The pilot also mentioned that there are remote areas where no radar system is able to track the location of the plane.

Our conversation also covered information about the direction of a magnetic compass in relation to the North and South Pole. The magnetic compass points always north. The magnetic field of the Earth is the same everywhere. Every few thousand years the North and South Poles swap their polarity, however this does not happen from one day to another; it might take 100 years. Finally, we discussed the value of making bespoke objects in comparison to mass-produced objects (such as smart phones) which the pilot described as being sterile and clinical. The pilot shared an idea of a compass that points always home that inspired the design of the *Personal North* piece (see Section 4.3.4 for specific description of the piece).
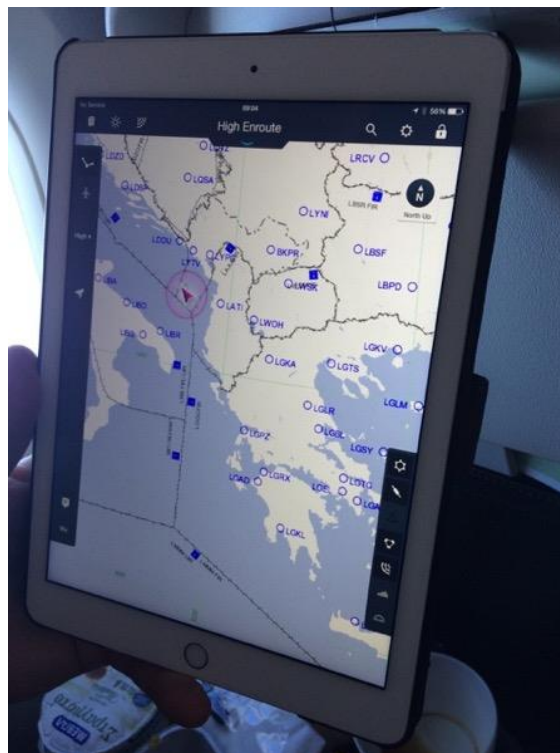
Figure 4.6-1 Radar zone mapping. In conversation with a private pilot during a flight.

4.7 Sketching with Participants

In this section I will describe the sketching method I developed during the research and how participants evolved (or not) with the method during the participatory engagements. Firstly, I will introduce the development of this method within the *Air[craft] workshop* and then I will reflect on how the method evolved with each participant. Insights about the method will follow in Chapter 5 (see Section 5.5 p.204).

4.7.1 The Evolution of the Method

In Section 4.5, I described the *Air[craft] Workshop* and the design probes that I have created for this particular context. In this section, I will focus on the *Parts of Me and You* probe and I will explain how an iterative sketching method developed throughout this research (see Section 4.7.2). I briefly remind the reader of the start of the visual dialogue (Stage 1) and the deployment of the probe during *the Air[craft] workshop* (Stage 2).

Stage 1. An initial meeting, pre-*Air[craft] workshop* with each participant (Diane, Jude and Laura) gave me insights into their lives. From the things they shared, I created a sketch for each participant that included things that reflected their feeling of home and *being in-between* (see Figure 4.7-1).

Figure 4.7-1 Sketches made for each woman after to help them visualise aspects of their sense of self. The sketches featured a female figure at the centre representing each woman and were then divided into home (left) and work (right).

Stage 2. During the *Air[craft] workshop* each participant was given (within the group of 6 probes) a sketch-based probe comprising of an A1 sheet of paper with the sketch composition that had been drawn for each woman in the centre of the

page. The participants were asked to draw things that they thought were not represented in the sketches and that felt missing to them. Figure 4.7-2 (below) shows one of the participants' sketched responses.
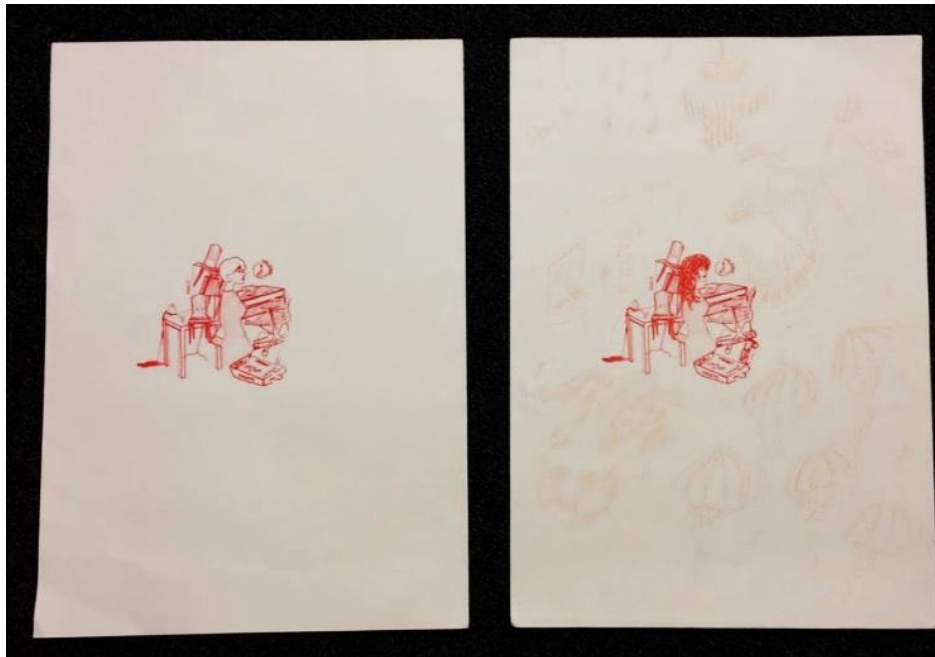
Figure 4.7-2 (left) The initial sketch for Diane (screen-printed at the centre of an A1 sheet). (right) Diane's sketched response on the probe during the *Air[craft] workshop*.

In the group discussion immediately after the workshop, the participants made it very clear that the sketching probe had been the most interesting and reflective opportunity for them within the workshop. It was clear that they had perceived value in the process and the sketches themselves as artefacts. From this point I sought designedly ways to continue the visual conversation as there were clear indications that sketching was providing an interesting modality for the exploration of feelings and suggested meanings that the women attributed to a sense of being in transition. After the workshop, I began an intuitive engagement with participants' reflections led by being responsive to the images, materials and ideas that the women had shared and developed into a more reflexive sketching process over time and a specific method of using sketching.

4.7.2 The Method

The method involved iterations of **Stage 1** and **Stage 2** (see above) by taking the initial sketches made for each participant and screen-printing the sketch onto the centre of an A1 sheet of paper. In Figure 4.7-3 I visualised this process. This process allows them capture how they felt about themselves and how they saw the relationship between the places they consider home in a visual way.
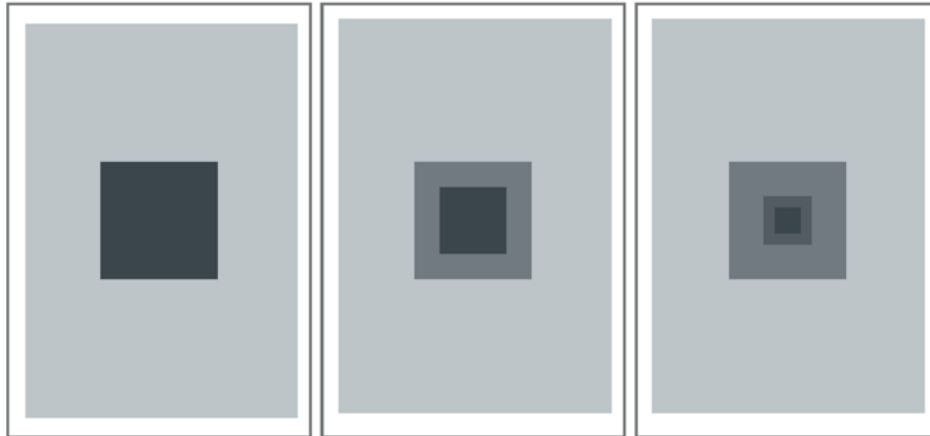
Figure 4.7-3 Visualising the sketching method.

After participants had drawn their responses the whole A1 sheet was then scanned and reduced in scale and reprinted onto the centre of another A1 sheet of paper. In this way, a constant flow of sketches could be created like a dialogue going back and forth between us. The effect is one of condensing visual imagery in order to free space around it for further sketching and the selection of certain elements from the sketches to be the focal point of this new layer of interpretation and meaning. Throughout the study, all sketches were given to each participant in copies of two; one for them to keep as a gift and another as an invitation to draw things they wanted to as a response to the sketch. Although I believe this system of reducing sketches to create space for new layers and a visual continuity of dialogue to have much value, as with any new method I was open to how the participants responded to it over time.

4.7.3 The Sketching Processes

At each meeting with each participant I had produced a new sheet that retained elements of what I had drawn previously and things that they had added to this – which were shrunk (but still legible) into the centre of the A1 page – leaving white

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space all around for the participant to add a new layer of responses. For most of the sketches, a pencil and tracing paper were used to trace elements of pictures that participants had shared and to freehand sketch (see Figure 4.7-4). I firstly traced what were considered to be key parts of the images and I added other elements with freehand sketching. In this way, layers of tracing paper were used to combine elements (which were then inked). Elements that were considered more important were placed in the foreground of the sketch, leaving other elements in the background. In the next sections, I will describe how the participants engaged with the process and how I adapted it in order to continue a visual dialogue with them over time.

Figure 4.7-4 The development of a sketch for Diane. Using a pencil and tracing paper to trace elements of picture that she had shared with me.

4.7.3.1 Sketching with Laura

Figure 4.7-5 and Figure 4.7-6 show the development of the visual dialogue with Laura. I followed a process of shrinking down the initial sketches and centring them in the middle of a large A1 sheet of paper, thereby allowing Laura to see how her narratives evolved by adding her own reflections. The iterations of sketches

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depicted images from pictures that I received from her, elements of her probe responses during the *Air[craft] workshop* alongside my interpretations of what was important for her in each of the locations of home. Key things in the sketches were the sea and the mountains (Figure 4.7-5 left). In Figure 4.7-5 (right) I inked the sea and the mountains from Laura's response to the sketch-based probe, thereby emphasising the significance of nature in both locations. I screen-printed the new sketch on an A1 sheet.
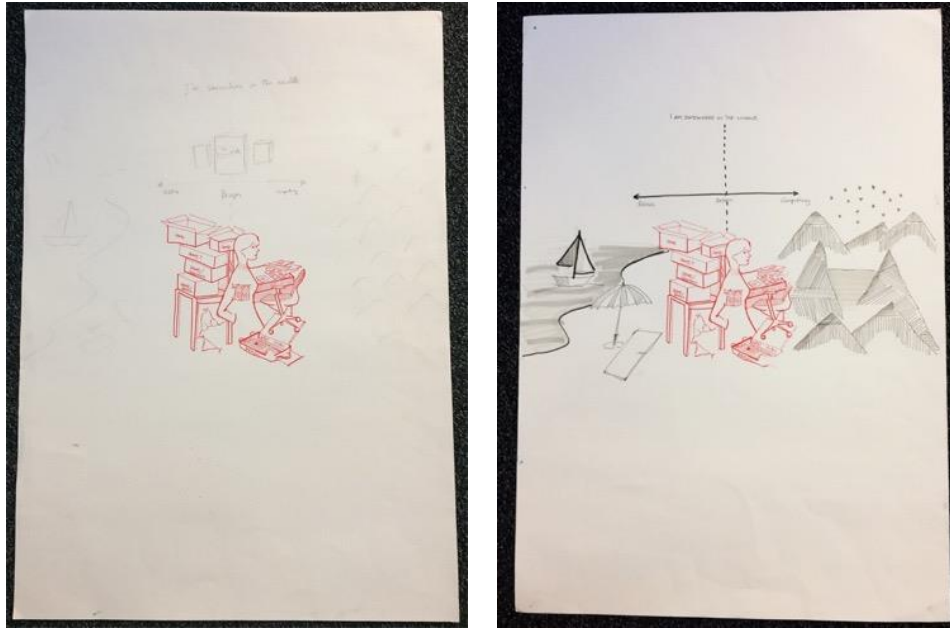
Figure 4.7-5 (left) Laura's sketched response on the sketched-based probe. (right) My next iteration of sketching.

Shortly after I received a small number of photos from Laura that were significant to her, I responded to the pictures with another iteration of the sketching, where I added a layer of sketches of two of these images. These images were screen-printed as silhouettes of female figures, one climbing a mountain and the other at the top of the mountain. (Figure 4.7-6 top). I sent this iteration of the sketch to Laura via the post and she visually responded to it by sketching her reflections and deleting some elements of the drawings (Figure 4.7-6 bottom). When we physically met again we discussed her reflections and what we had presented to her as a piece of digital jewellery inspired from the sketch and her love for nature.
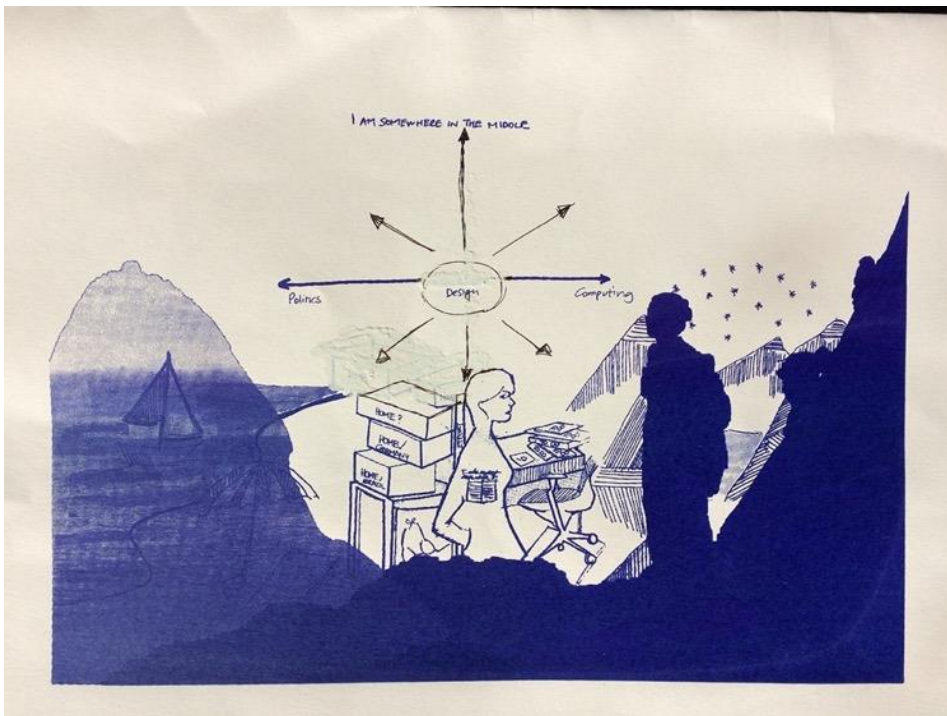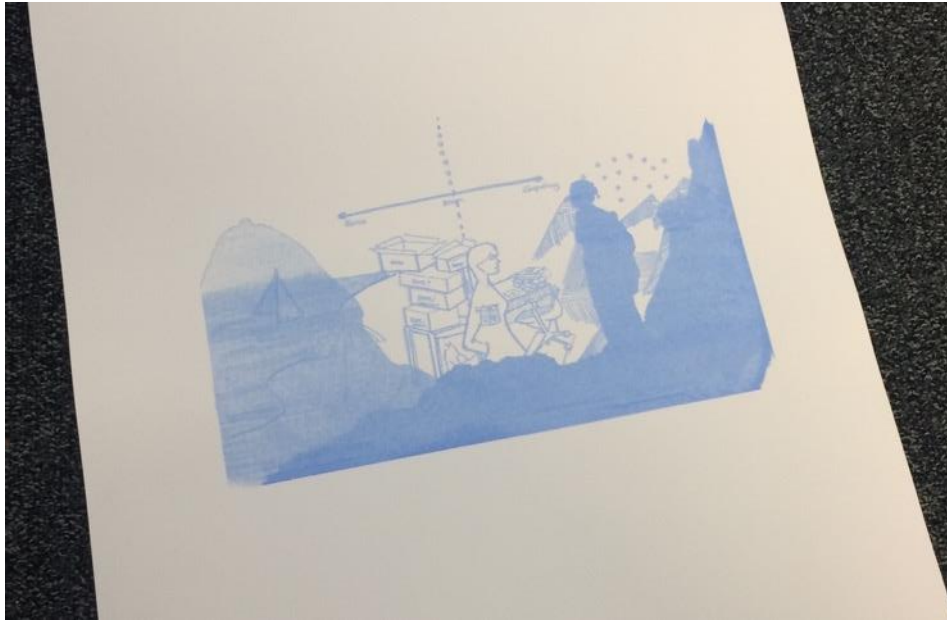
Figure 4.7-6 (top) My third iteration of sketching. (bottom) Laura's visual response.

In two years, Laura went through the transition of buying a new house and settling down in a city. I felt that finding the space and time to explore a transition of going back to her home of origin was challenging, however this was something that she wanted to attempt. To overcome this challenge, I found sketching taking on a different role. This time it was a way to capture what Laura was going through at the current moment (see Figure 4.7-7). Figure 4.7-8 shows Laura's response to

my sketch for her transition into the new house. Although the focus of the study was not to capture all the transitions my participants were going through over time, it was important for me to keep the conversations going and to allow the process to evolve in ways that felt right for participants and which could be led by them at all times.

I repeated the method of shrinking down my initial sketch for another transition in her life and centring it in the middle of a large A1 sheet of paper. Laura responded to the sketch with a new sketch. One key aspect in this sketch is again her connection with nature. During the phone conversation, Laura shared with us that the main reason why she has chosen the property was because it was close to a park and a river. As depicted in the sketch the nature gets into her house as this is a fundamental part of her life. I felt that her sense of self was unbalanced, thus I drew a silhouette of a woman who is balancing on a rope. In her sketched reflection (see Figure 4.7-8) she deleted this figure, the wet paint on the wall and some removal boxes from the composition. She added a fire and three people sitting around it. She put the whole composition inside another circle, which could indicate that this transition is not separate from the rest of her life.

Figure 4.7-7 (left) My sketched response on Laura's life transition (centred on an A1 sheet). (right) Close look at the sketch.
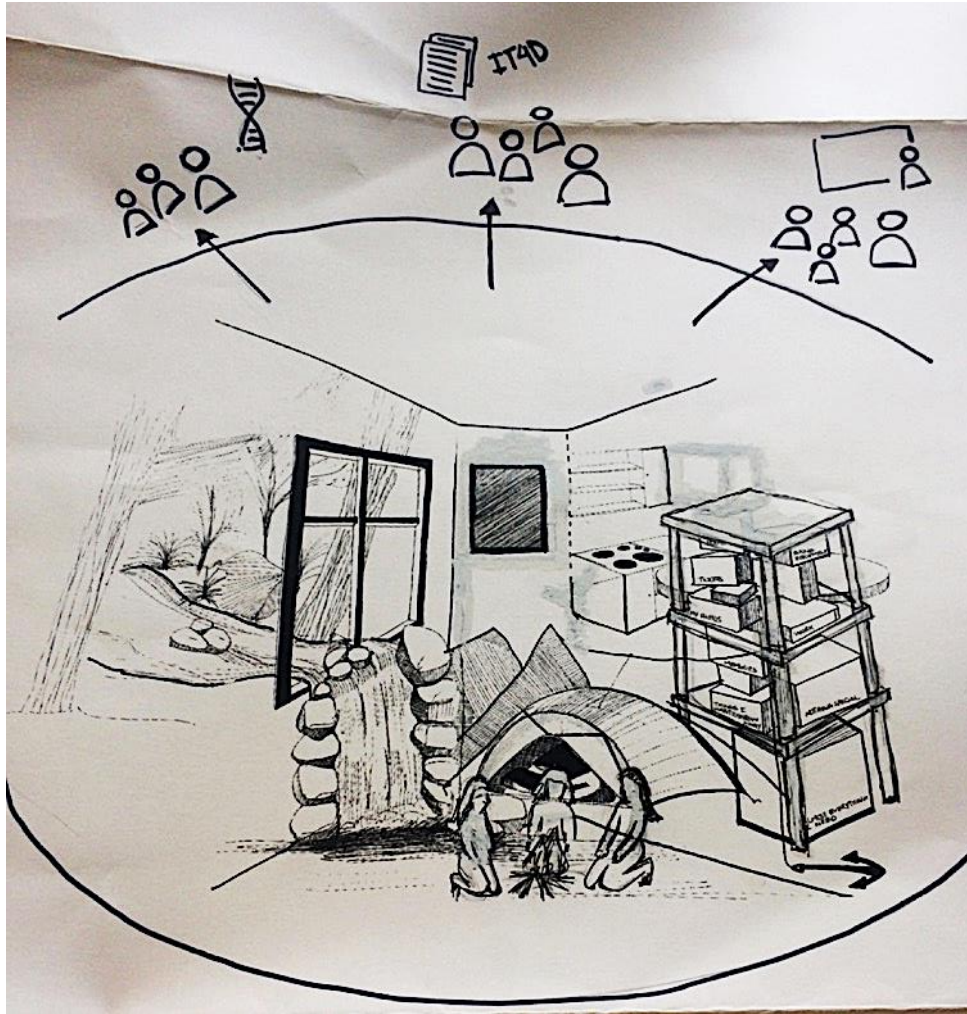
Figure 4.7-8 Laura's sketch as a visual response to my sketch.

4.7.3.2 Sketching with Diane

After the *Air[craft] workshop*, in my attempt to reflect on Diane's stories and the experiences she had shared with me I made a series of sketches that captured places, buildings and locations with personal significance including Diane's home town (see Figure 4.7-9), the UK town where she now lives and works and a city that she feels closely connected to (see Figure 4.7-10). With the sketches I found a way to be sensitive to her wishes to not discuss family matters, leaving the ambiguity of the images to create a space where she could fill in details about her life and her feelings of being in-between.

During our next meeting, I showed her the sketches. Diane was touched by the sketches and she shared with me personal stories by focusing on different parts of

the sketch composition. She added layers of personal meaning as she verbally combined details of the drawings in new compositions and talked about different elements coming together:

> *This is the bridge over the river. I don't know how you got that to be honest, it is amazing. Because I can recognise that right away. This is obviously the bridge from the city, and you got like the curve of the river and I don't know if you knew but what comes at this point if you would follow the river it would be the street that goes along this building, which is so easily recognisable. [Diane]*
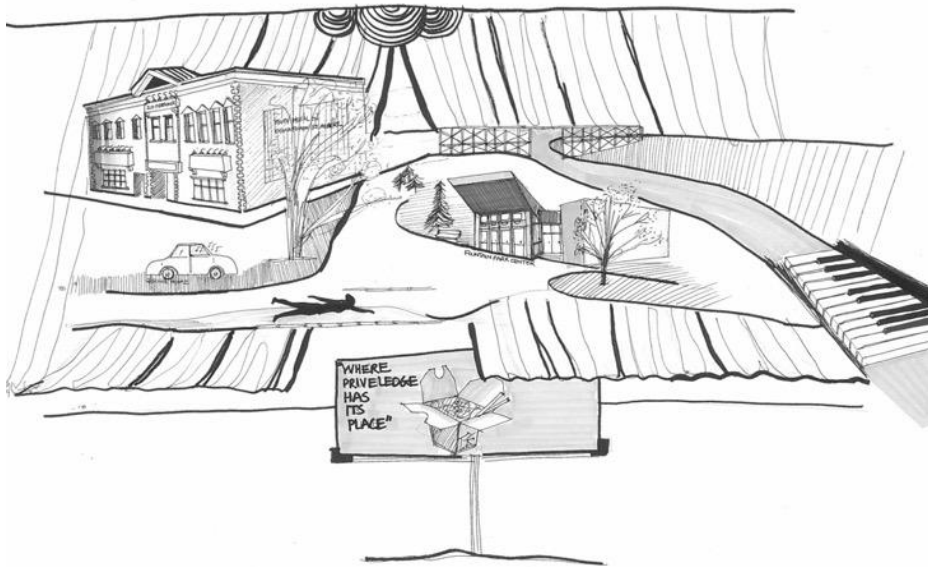
Figure 4.7-9 Diane's home town. The sketch illustrates Diane's memories of her childhood and places that she visits when she goes back to her home town.

> *In the image, especially this one with the street that comes towards us, in this, it is sort of runs past us. But in your images, there is a real sense of movement amongst the cities. When you are in the city there are all those different aspects of the city, maybe it's interesting to me that are all memorable to you as you move through the space you might move closer to one in a way from the other, but even though you might be here, this part of the city is always influencing you. [Diane]*

Soon after the meeting I sent her two copies of each sketch in the A1 format and a new sketch from [a city], a place significant to her. On [the city] sketch I added elements from her sketched response during the workshop, details of the images that I received from her and a sketch of the DIY Music Kit probe(on the left side of the sketch) (read about the probe on p.141) which we have discussed in one of our previous meeting.

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Figure 4.7-10 The sketch depicts places and objects that hold memories and stories from a place where Diane has a special connection.

The drawing of (favourite city), brought me into tears - you really captured the stories I told you. It is marvellous to see how you brought to life all these details in one composition. I am looking forward to do some additions to the composition as you suggested [Diane]

Diane was not able to engage further with the research due to events in her life, and thus, did not respond to the sketches visually. However, the sketches served to elucidate rich conversations on issues that mattered to her until her withdrawal. Through the sketches, I was able to visually interpret what she shared with me in the previous meeting and reflect it back to her during future meetings, which was an effective ice-breaker. I saw that the sketches were a sensitive "way in" to a conversation and an easy way to connect with things that she found significant from all three places.

4.7.3.3 Sketching with Jude

Similar to Laura, Jude faced new transitions in her life. Family issues, finding a new job and moving to a new city changed her priorities during our time working together. One of the things that I did was to have telephone conversations about things that were changing for her life whilst she was back home. My response was to capture the conversation and sketch what was being spoken about. When we physically met again, I gave her two printed copies of the sketch and I invited her to draw her feelings and thoughts on the sketch or add the things that she felt were not captured. Jude did not engage with the sketches in her own time, however when we met again, she suggested drawing things on one sheet together in a collaborative way (Figure 4.7-11). We did this with some degree of success, however we each found sketching together difficult as a dynamic. It did not feel personal and neither of us were able to connect with the sketch. It felt forced as we did not have the time to sketch at our own pace. What we produced was more like note taking or brainstorming. We started labelling things and we constructed meaning for the sketch together in an analytical way rather than through developing sketches based on intuitive responses.
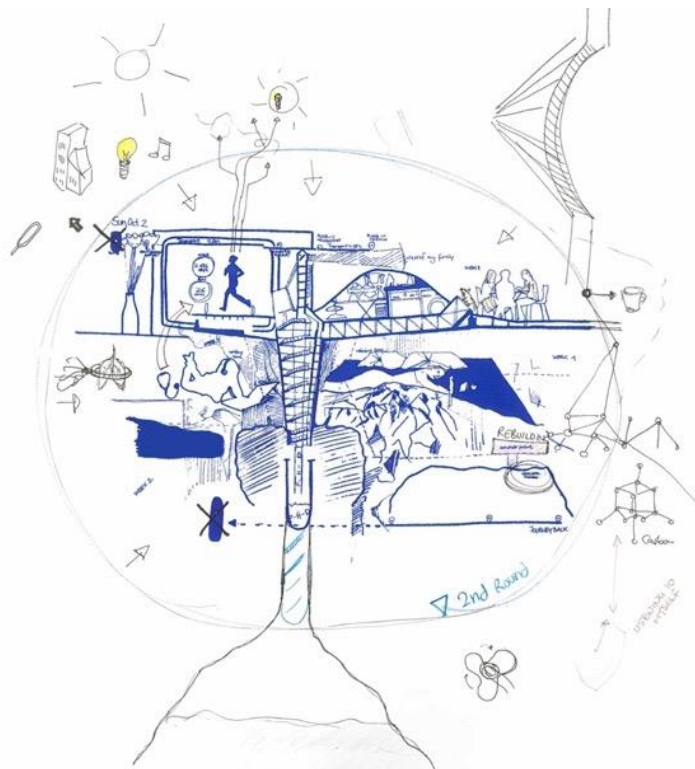
Figure 4.7-11 Sketching Together with Jude

4.8 Exploring Opportunities for Digital Jewellery

The *Air[craft] workshop* and the visual dialogue with the sketches gave me valuable insights that accompanied those of my own regarding what it means to travel between two 'homes'. What I learned from the three participants enabled me to create a series of ideas for digital jewellery (not only forms but interactions and insights for how they might be able to support self in micro transitions). The insights are presented in next chapter (p. 194).

I stated earlier in the thesis that methodologically I did not make things for each participant, yet I was inspired in a general sense from insights from them, my own experience and conversation with experts in aviation. These dialogues informed my thinking and direction of what digital jewellery could be in the context of micro-transitions. In order to add depth to my explorations and push me to explore new creative contexts for design, in this part of the research, I introduced a set of objects (four in total to each participant during the one-to-one meetings. These objects acted as stimuli for ideas on digital jewellery to support self through micro-transitions and were inspired by the participant's reflections during the workshop, conversation with experts and my own lived experience. In this section, I will describe the pieces and present the conversations around these objects that shaped my ideas on digital jewellery (for the final pieces see Section 4.9 p.149).

4.8.1 Thimbles and Microfilms

Figure 4.8-1 (left). Found thimbles. (right). Looking through the black peep on a Stanhope thimble, one can see a tiny image hidden within.

Stanhope Thimbles (see Figure 4.8-1) are objects that hide a tiny image. The black "peeps" are miniature photographic lenses, incorporated in different objects from the mid-19th century onwards and thimbles were an example of such objects (Oatman-Stanford, 2014). When held up to the light one can look through the lens and view the microscopic image with remarkable clarity. The thimbles are found objects from one of my visits to the Tynemouth flea market in Newcastle.

Inspired by finding this thimble and the suggestion of looking into a hidden world I began an exploration (inspired by my own and participants' reflections on the value of connecting with both places during the transition see p.197) into the potential of using aspects of *Stanhope thimbles* within digital jewellery.

I introduced the *Stanhope thimbles* to the participants and used them to invite them to consider what was important for them in each of the home locations and to start to think of a piece of digital jewellery that could perhaps hold microscopic images that may connect them to things that were of significance to them on a personal level in relation to both homes. I asked them to contribute a small number of photos that represented personal anchor points – literal or metaphorical. For clarity, I use anchor points to refer to personal meaningful connections.
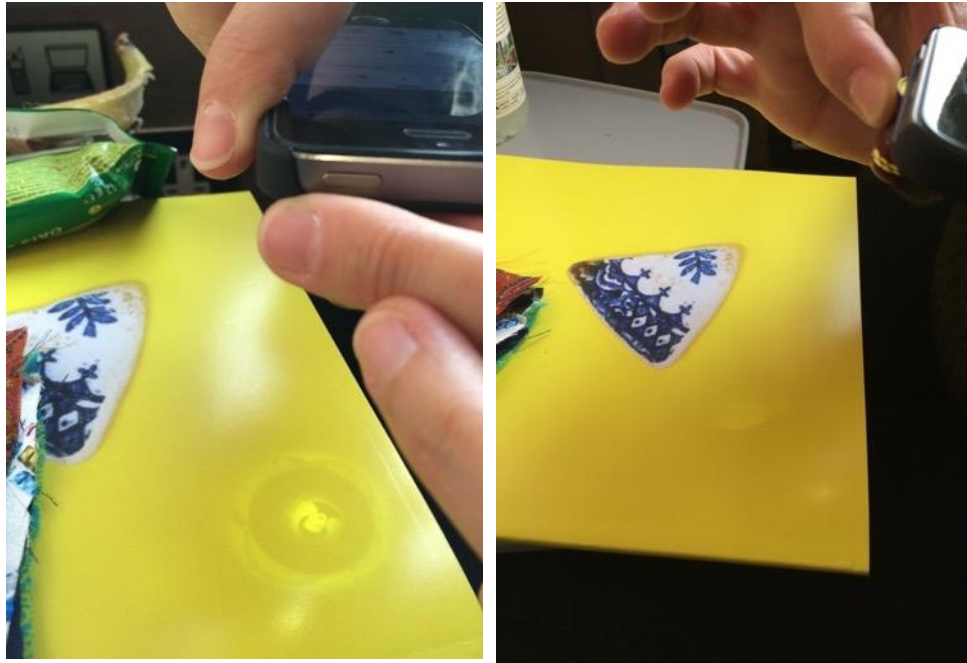
Figure 4.8-2 Jude's explorations with a Stanhope Thimble during our meeting. The meeting took part during a train journey.

All three participants were fascinated by the tiny scale of the image and the intimacy of the interaction and they were intrigued by an object that could hold images from both locations on such a tiny scale. Jude explored the piece during one of our meetings and she found out that the image can be projected on another surface. Jude used the flashlight on her phone and projected the image on the surface in front of her. The further the light source was from the image, the blurrier the projected image became. Reflecting on the different ways one can view the image (projecting on another surface, or looking inside the piece), Jude reflected that looking through the glass made the interaction secretive and personal to her. She found it intriguing that she was the only person that could see the content inside the piece (see Figure 4.8-2).

Laura, Diane and Jude all sent me photos that were significant for them from both 'homes' and I created tiny microfilms from the pictures I received in collaboration with the Archives and Collections Department at the Woodhorn museum which I shared with all of them in future meetings. The process of creating microfilms from personal images was something that the staff in this department have not yet explored, however it was an area that they wanted to experiment with the purpose of this research. As this process was new to them, they experimented with different parameters. They explored the distance between the lens and the image, different light conditions and formats. As a result, I

received many copies of the same image that were in different sizes, contrast and both negative and positive formats (see Figure 4.8-3).

Figure 4.8-3 Microfilms from participant's personal images. The microfilms were made in collaboration with Archives and Collections Department at the Woodhorn museum.
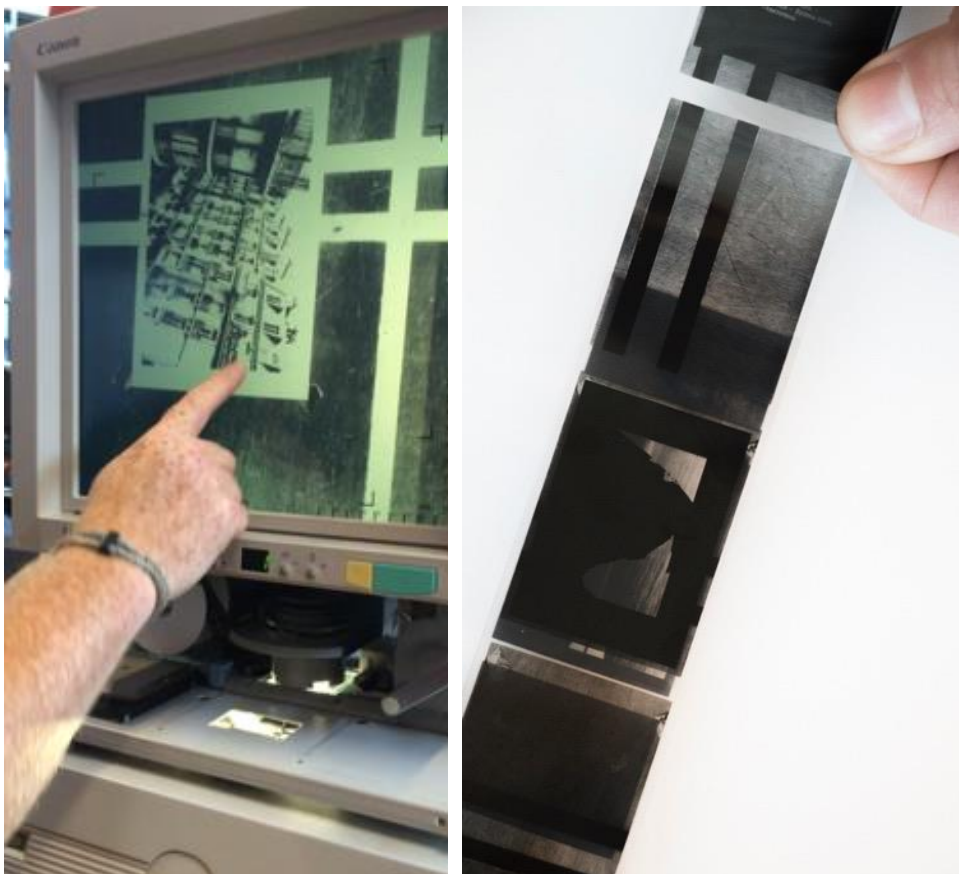
Figure 4.8-4 (left) a. A member of staff at Woodhorn Museum is showing me how to use the microfilm reader. (right) b. Exploring the materiality of microfilm. Blending two layers together.

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. Rather, it allowed me to create a stylised image that would still be recognisable 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 4.8-4), allowing someone to blend certain parts of the pictures with another image.

Laura's microfilms (see Figure 4.8-4), included an image of her hiking, one of her being on the top of a mountain. Laura found herself reflecting on her life and her feelings of being in-between through adding to and discussing the microfilms.

> *This is actually me, very me […] Climbing is part of me and it contributes to who I am […] I remember when I was at Everest […] and I was sick, but I got the to the top - I did it! I am really proud that I did it! It is like a reward being on the top - That's how I feel when I look at the picture - it is an achievement. [Laura].*

Jude reflected that all the objects in the microfilm images represent different times and places in her life, thus, they are all parts of who she is. Jude thought of a piece of digital jewellery that could support the continuity of her sense of self and follow her changes in life. She imaged a piece that could hold all the microfilm images (in layers) that are important to her from her home locations leaving an extra space for a new narrative, an image from her future home. It brings her comfort to know that all parts of her life are with her. *"Home is with you wherever you are. All the pleasant feelings of both locations are in the piece"* [Jude]. Jude talked about the layering of microfilms as a way of playing with time. In her idea, the most recent picture pushes images from other times in the background and, thus, they become blurry and darker the further they are from the lens and the light source.

Diane explored the physical interaction with the microfilms in her own time. She played with the distance between her eye, the lens and the film and once she figured out how to use them, she was intrigued by how much details the microfilms had. Being able to focus on detail, for example, of a wine glass on a table in one the images drew her attention in revealing different layers of the images at different times. She reflected that the slow and very careful interaction with the films gave

her time to reflect on the meaning of the image and that was something that she really valued.

4.8.2 DIY Music Kit
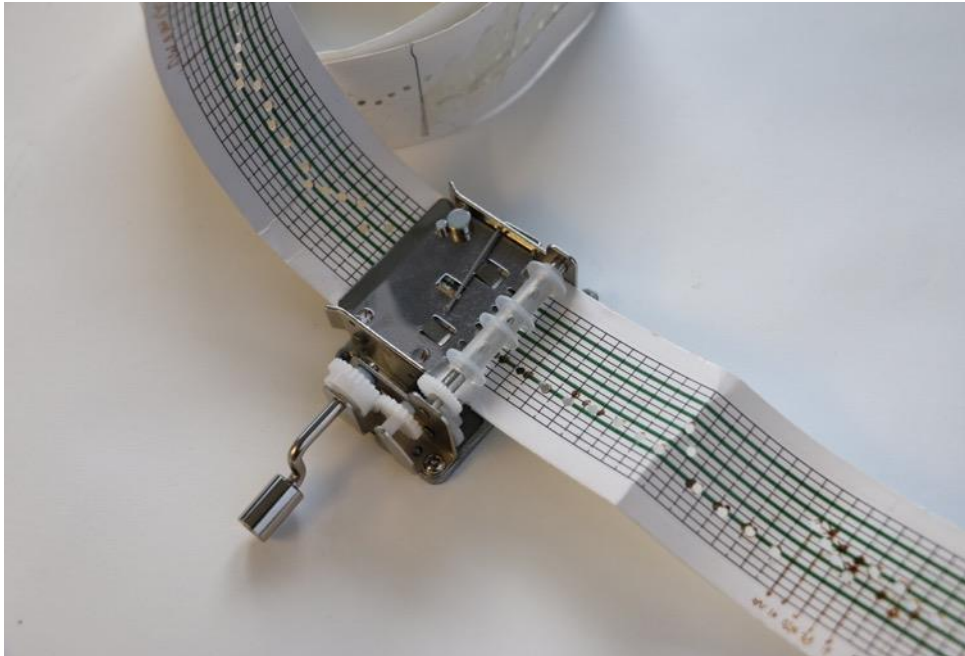
Figure 4.8-5 DIY *Music Kit* Probe for Diane

The *DIY Music Kit* (see Figure 4.8-5) consists of a mechanical mechanism, a paper strip with musical notations of George Brassen's song *La mala reputacio* and empty notations that allows someone to create his/her own melodies. Diane has a special connection to this song. The music kit brings together her love for music and (anonymised city), inviting her to explore alternative ways of connecting to moments of being cheerful, relaxed and herself. In (anonymised city), Diane finds herself to be *"the person that [she] wants to be"*, away from family and work, she can relax and retreat. I invited Diane to write her own version of the song and prompt her to think if/how digital technology could add value to the piece. Insights from the meeting with Diane informed conversations with Laura and Jude in future meetings.

Diane's first reflection focused on the significance of the piece in her life. The music box and the snippet of song transported her to a time and place in life where she was perfectly at ease. *"I'm glad you've chosen George Brassens songs and not an obvious from Edith Piaf. […] this one is much more personal"*. Diane linked the

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song with memories from the place and she commented that *"it's really perfect that you have chosen that, I think it's really good"* [Diane].

She listened to the tune at home and took the opportunity to give herself a few minutes of momentarily transportation. In her reflections she said that *"this would make me happy and anticipatory if a trip to Paris was already planned, but rather wistful and sad if I had no plans to go anytime soon."* [Diane]. Finding the space and time to pause and reflect was very important to her and she highlighted that this can be very challenging during the journey.

In a follow up meeting, I shared with Jude and Laura the *DIY Music Kit* exploration and Diane's first reflections. Laura commented on the power of music to transport her in different times and connect her with good and bad memories of home. Jude commented that music is not something that she is particularly interested in, however, she talked about the qualities of the microfilm in comparison to the mechanism and the paper strips of the Music Kit. She highlighted that the microfilm images have a very clear and detailed message that is fixed, whereas the music paper strip is less obvious and more flexible. The device she said *"is the mechanism, but the paper is not limited to a specific context. You can always create a new song or think of the paper strip as a code that can activate something else"* [Jude]. Jude used the word "codeness" to describe this characteristic of the paper strips. Similar to a punch card that contain digital data, the paper strip contains information that can be translated into different things. The paper itself *"can be more than a music code, it can be a code to light up another object or to knit a new pattern"* [Jude].

Jude's reflections informed my conversation with Diane in a follow-up meeting, when we talked about the qualities of the paper, the device and its connection to digital data.

Diane commented on the different qualities of the paper and the mechanism. The mechanism was not enclosed in a box and thus one can see how it works, revealing step by step the interaction: *"Even when you're holding it in your hands and it works straightaway it is hard to see how it does it, but you know it's really simple because there is no part that is concealed. Everything is there."* [Diane]. The physicality of the paper to wear and tear over time made Diane think about the fragility of the medium and its significance over time: *"You know you have to be careful with it, but then you have to turn with quite a lot of enthusiasm to make it sound right, you cannot be hesitant otherwise it doesn't work"* [Diane].

This suggests that an analogue device allows a person to craft the data. With care and precision, the notes can be translated into holes on the paper. The distance between the holes can never be exactly the same, thus all the variations of the same song will be slightly different. Thus, every song in the paper strip is unique as well as tune that creates. A person turns the crank as she/he is adjusting the pace constantly. Diane commented on the time she needed to spend to make the device work *"I was playing it by myself, it didn't sound right and then I tried it again. Then I realised I need to play at least double the speed, otherwise it doesn't work at all. […] And then the song has quite a rhythm to it and then you can sort of find your rhythm and spin it."* [Diane].

Jude's idea of mapping data from one device into another form (or function) is a very direct way of thinking. The encoding of the message into a form can be seen as being an automated process. Diane's reflection on the *DIY Music Kit* inspired me to think about the manipulation of data as a craft practice that can be very personal and unique to a person who creates it as and is unique and idiosyncratic to the person who interprets it. This understanding informed the making of the *Chronos Brooches* (see p.156).

4.8.3 Compass of Ourselves
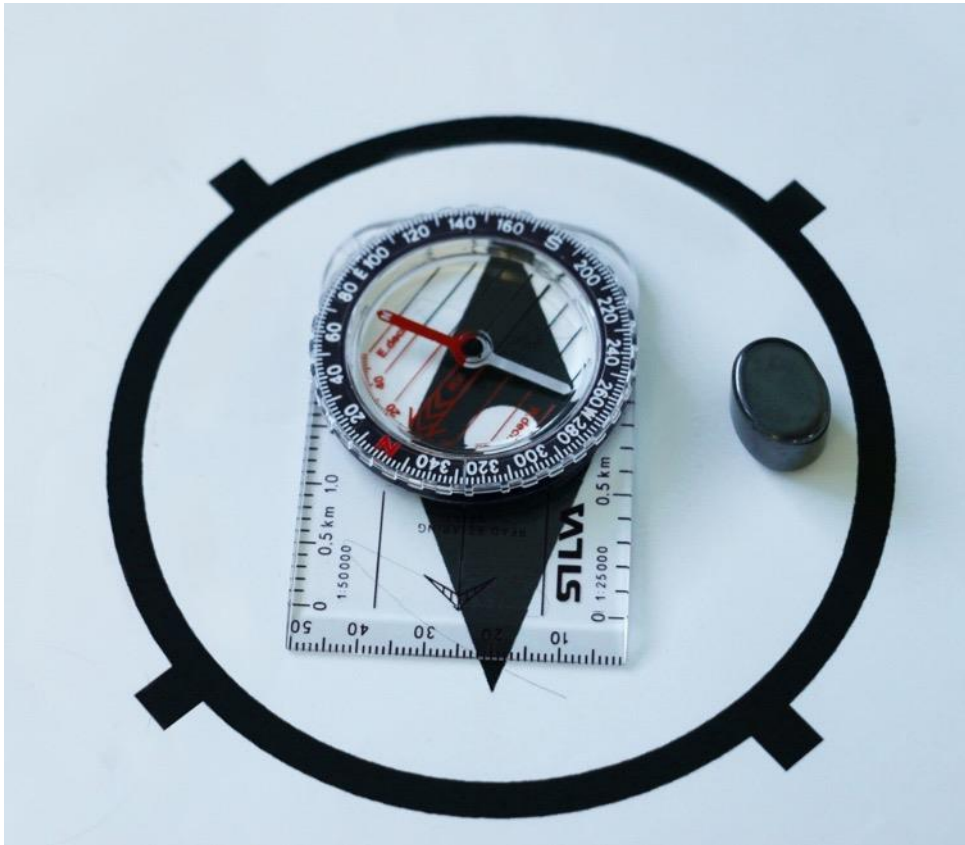
Figure 4.8-6 *Compass of Ourselves*

The *Compass of Ourselves* (see Figure 4.8-6) is a piece comprised of a compass and a piece of hematite. Hematite is a common rock-forming mineral with magnetic properties. During the participatory engagements with the participants, I asked them to imagine: *Where does their personal compass points to?* The magnet was introduced as a metaphor of their redirection to their anchor points during the transition. This exploration was inspired by Laura's reflections on the *Neither Here nor There* probe (see p.119) that:

> *The clock is a good metaphor of how I feel about transitions. The slow coming and going, but stayed in the background of actions. I probably, wouldn't call it a clock though. Maybe I would call it a compass that points towards ourselves [Laura].*

Participants highlighted that anchoring their compass to a specific location was not something they were engaged with. Laura's compass did not have any dials. She imagined instead her compass revealing things that are significant to her from time to time. The specificity of the compass to direct towards a specific place was

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not something Jude could relate to either. Her personal compass had multiple dials which were pointing to different directions and she imagined reflecting on the different direction based on the things that are happening in her life. In her words:

For me, in a way the compass has more than one needle, to show that is not just one direction, one way to go through life, with the many different ways, or traces, you can go this way and that might lead to different directions [...] I could play with the magnet and the compass and see how do all these fit together in my messy head. [Jude].

Figure 4.8-7 Photo taken during the meeting with Laura (left) Jude (right). The meeting with Jude took place during a train journey, following Jude's transition of moving to a new city for a new job.

Diane enjoyed the interaction between the magnet and the compass, however she could not connect with the existing use of the object (to point to a direction). She enjoyed the fact that the piece was moving with her and constantly redirecting itself. However, the needle did not follow exactly her movements which surprised her and drew her attention to the qualities of the interaction, rather than the meaning of the object in her life. She described the piece as *"a balanced object that you can control without really touching it. I imagined the piece as a concentration tool, I thing is very charming to see that it moves when I move my hand. I like it."* [Diane]. For each participant, these reflections brought insights regarding the idea of home and the notion of belonging which I present in Section 5.3.1 (p. 194).

4.8.4 Sea Pottery

Figure 4.8-8 *Sea Pottery*

The ceramic shards shown in Figure 4.8-8 are pieces I have found in beaches in the North East of England and Scotland. Sea pottery are pieces that change over time. Their edges are rounded, worn out, evident of witnessing a change. There is a haunting quality about this change to me. How did they end up in this beach? They tell a story which often links with our experiences of that place. A piece was once part of an object, keeping some of its references of time in its form. This was a metaphorical link between the pieces of sea pottery and the self in/between two places that inspired me to use them as a probe in the follow-up meeting with the participants. This exploration was also inspired by Jude's reflections that

> *Found objects on the beach, shells or smoothed glass shards have always fascinated me. I like to collect random things from different places. […]. The nice thing about it is that I found it. I found it on a beach in England and I attached my experience of that with the object. It doesn't matter where it comes from, I made up a story around it of why and how it got there[…] [Jude]*

To instigate further thoughts around such objects, I conducted informal one-to-one conversations with a small group of colleagues and I asked each participant to select a *Sea Pottery* from a given collection and create a narrative around the piece. I gathered all the reflections in a visual document, which I shared with Jude before

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our next meeting (pages of the visual document are included in Appendix A p. 247). The *Sea Pottery* was presented to all three participants to instigate further thinking of the potential of digital jewellery during micro-transitions.

During our meeting, inspired by the *Sea Pottery*, Jude and I discussed an idea for a piece that connects with a second piece and act as key to unlock a function. For example, the piece could be a lamp switch or a trigger for an audio tune when she arrives home. Jude critiqued this view of *"a piece that completes another one"*, as it offered a narrow view of what digital could be in this context and invited us to consider *Sea Pottery "not actually like a piece of another thing, but as fragments of something else that forms a new identity"* [Jude]. Jude selected a piece from a give collection and kept it in her pocket for a couple of weeks. She reflected on how the soft feel of the piece that made feel comfort as it had started wearing a little bit already, taking on some of the blue colour from her jeans (see Figure 4.8-9). The piece made her think of what home means to her especially during the time that she was moving to a new city. She imagined a digital piece that she could wear and/or change over time as part of her daily life. The digital could change its context each time she wears the piece and, thus become a piece that is unique to her because it follows her rhythms in life.

Figure 4.8-9 Jude's sea pottery. Jude kept the piece in her pocket for a few weeks. The piece took the colour of her jeans.

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When I presented the *Sea Pottery* to Laura, she *"felt like putting them together again"*. Laura talked about the Japanese technique of fixing broken pottery, known as Kintsugi. She commented on the pieces as being parts of other times and she suggested that a piece that could connect her with the present moment in her life would be of a greater significance to her. Members of her close family could have parts of the same piece and when the pieces are in the same location then a new function could be activated. She suggested that a new piece, which is created when people are together, allows access to another function, thus gaining different values and characteristics from the initial found piece. A piece that is part of bigger whole was an idea that Jude also explored where she knitted a number of crochet balls for her close friends. She gave a piece to each friend and shared a picture of all the crochet balls with each of them. She wanted them to feel part of a larger whole.

Diane commented that many objects in her house have "a sea pottery quality". The sea pottery quality for Diane is when she rediscovers a piece in her house and she reconnects with it. When she looks for something in her house, she stumbles upon something else and that is a special moment for her, because she has rediscovered it. In her words:

> *[An object] is not interesting when it is new, it is interesting later when you have forgotten then it comes back to you...Stuff that gets lost in your lifestyle and later when you came across over time it is more special again. [...] That is what I like about the sea glasses that it turns back up. It would to be a bottle and now it a thing, like a beautiful shiny thing [Diane].*

Diane was also referring to physical things as well as her digital archives. She still keeps her last iPhone, because it has *"100000 pictures on it and [...] there are still random bits that I have no idea how to deal with [...] I cannot bring myself to get rid of it"*. These reflections informed the *Travelling with the Sea* piece (see p.165).

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4.9 Digital Jewellery

This section presents the four pieces of digital jewellery made in this study (*Topoi, Togetherness: Anthos and Chronos, Microcosmos and Travelling with the Sea* see Figure 4.9-1). Within each section, I start with the description of the piece, followed by detail of what inspired each of them and the design development stages. This is a descriptive section; however, it does include my reflections-in-action during the making phases. Wider reflection on the pieces themselves, what they highlighted for digital jewellery practice, wider interaction design and HCI will follow in Chapter 5 (p.181).

Figure 4.9-1 (top left) *Topoi,* (top right) *Togetherness: Anthos and Chronos* (bottom left) *Microcosmos* (bottom right) *Travelling with the Sea* by Nantia Koulidou, 2017.

4.9.1 Topoi

Figure 4.9-2 *Topoi* by Nantia Koulidou, 2017. Milliput epoxy putty, coal, oxidised silver, magnifying lens 10x, found objects, electronics.
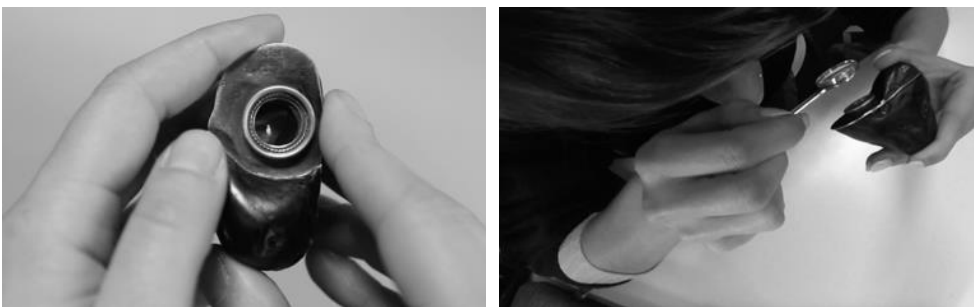
Figure 4.9-3 (left) Detail from the second layer of the microfilm when the light is illuminating inside the piece. (right) Looking through the glass.

4.9.1.1 Description of the Piece

Topoi (see Figure 4.9-2) 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. 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

A light source is required from within the form in order to view the images when using the magnifying lens and this is activated in response to human touch (Figure 4.9-3). When a person holds the digital piece, the surface of the piece, (being made of silver) conducts electricity and turns on a small LED light. The electronic components are a capacity sensor, an LED light, a Teensy 3.2 board and a tiny battery. The capacity sensor detects when the contact is made, and the LED light gradually responds to the human touch and pressure of the palm by slowly lighting up. When the contact is broken, the light goes out instantly, however, when a person holds the piece tightly for a while, the light reaches full intensity and stays illuminated for a brief period of time after contact has been broken.

With external light alone, only the first layer of microfilm images is visible, however 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.

4.9.1.2 Concept Inspiration

The concept arose from the design engagements with all three participants where discussions focused particularly on the value of meaningful connections (see Section 4.8.1 and Section 5.3.4) from both countries and the dynamic notions of home (see Section 5.3.1). 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 described earlier in

the thesis that concepts of home for Laura were always somewhat "in the background", however feelings and notions of home are "floating every now and then", slowly appearing and disappearing in her thoughts. 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, thereby bringing to the foreground certain aspects of home and senses of self in both countries. This interaction also draws on an insight from the research that having a bit of control over these transitions can be reassuring (see p.197, Section 5.3.4).

The piece also draws on inspiration from my exploration with the thimbles and the context of miniatures more broadly. 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 is highly valued during the context of this research (see p.197, Section 5.3.4).

4.9.1.3 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 with all of the participants. The form of *Topoi* draws inspiration from Laura's love for mountaineering 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 the country where she was born and the one in which she now lives. The microfilm images that are enclosed within the piece were developed in collaboration with the Archives and Collections Department at the Woodhorn museum (read more about the process in Section 4.8.1 p.137). The viewing hole of the piece incorporates the rim of a thimble and was inspired by a thimble that I found in a flea market that has a tiny little image inside to commemorate a royal wedding. A viewer is meant to hold the thimble up to the light in order to see the miniature image in the base of the thimble. The form of the independent silver magnifying glass echoes the shape of a mirror – my thinking was that this felt relevant as a mirror both reflects and reveals one's sense

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of self. It felt that the mirror-like lens and the rock shaped piece provided a metaphorical space where one can be together with just her/himself.

Figure 4.9-4 and Figure 4.9-5 show the development of the working prototype. For the first prototype, I integrated a temperature sensor (TMP36) with the SparkFun RedBoard. 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 made it difficult to return consistent results. Tommy advised me to look at the Teensy 3.2 board. 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(pin) 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 had been touched. This was done through trial and error, where Tommy wrote the code in a manner that allowed me to test and iterate these changes.
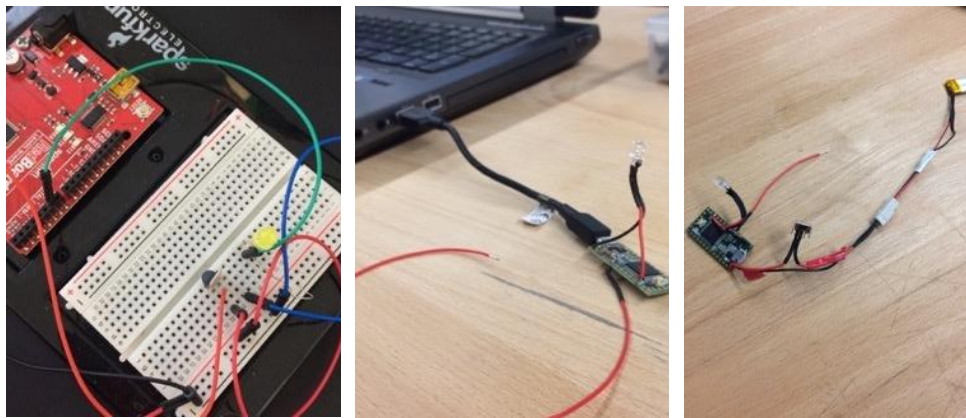
Figure 4.9-4 Working on the prototype. (from top left) a) Sparkfun RedBoard, temperature sensor (TMP36), LED. b) Teesy 3.2 Board, LED c) Teesy 3.2 Board, LED, JST connectors, push button, tiny battery.

Figure 4.9-5 *Topoi*. The prototype. Working with the form and the enclosed electronic components.

Figure 4.9-6 First explorations the form of the piece *Topoi*. Working with found objects, clay, milliput epoxy resin putty.

Alongside the interaction, I was experimenting with the form of the piece. Figure 5a shows my initial ideas to use found limpets as the viewing window. For clarity, limpets are sea creatures 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 limpet shell was challenging as the shell was brittle. Instead, I decided to use one of the found thimbles as a reference to where the idea of the piece came from (See more discussion with participants on Section 4.8.1 (p.137).

Concurrently, I was working with air-drying clay and later on with the milliput epoxy resin putty (black colour) in order 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 (Figure 4.9-6). I left extra space inside the piece for the electronic components, however I did not consider the extra space for the JST connectors which is required to attach the battery to the board. Figure 4.9-7 shows the final form of the piece with the enclosed electronics and layers of the microfilm.
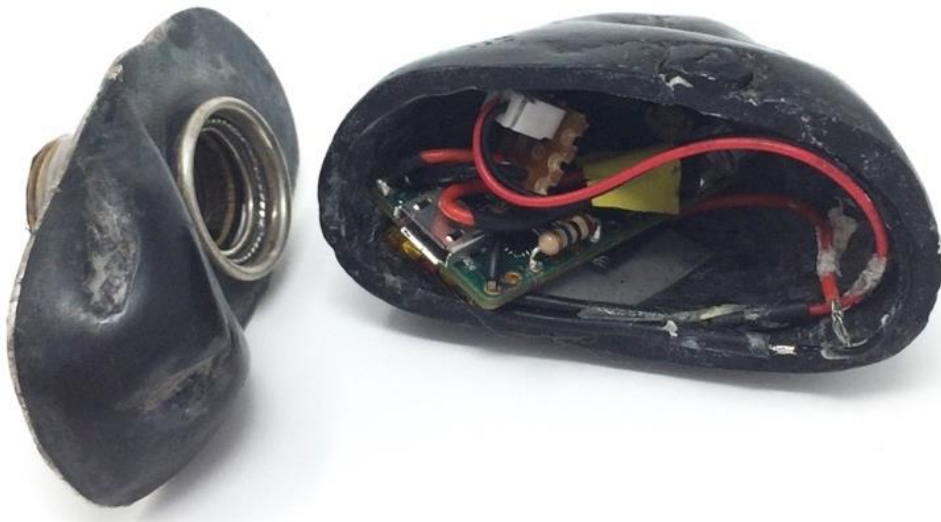
Figure 4.9-7 Inside the piece. Form reworked to make the electronic fit inside the piece.

4.9.2 Togetherness: Anthos and Chronos Brooches

Figure 4.9-8 (top) *Anthos* brooches by Nantia Koulidou, 2017. 3D printed wood filament, a found twig, silver and electronic components. 7cmx5cmx5cm

(bottom) *Anthos* brooches worn by two people in two countries. Photographer: Shiro Inoue

Figure 4.9-9 *Chronos* brooches by Nantia Koulidou.2017. A found twig, coloured
resin and stainless-steel pin. 2cmx2cmx2cm

4.9.2.1 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 (Figure
4.9-8). 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 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 (Figure 4.9-9).

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 (Tinyduino 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 of
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 then recorded and stored. As
such, the brooch pin itself acts as the 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

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Anthos brooches were worn. Once the twig has been dipped into multiple layers of different colours of resin the piece is cut open to reveal a cross section of coloured rings (Figure 4.9-10) and the forms are made into the new *Chronos* brooches through the simple addition of a stainless-steel pin.

Figure 4.9-10 Developing the *Chronos* brooches. (top left and bottom). Cross sections of layers of coloured resin. (top right). The process. The twig has three layers of resin.

4.9.2.2 Concept Inspiration

The pieces arose from design engagements (see Section 4.8.4) with two of the participants (Jude and Laura) and my own lived experience. Discussions particularly focused 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 (see Section 5.3.4). Laura's reflection on the *Sea Pottery* (p.146) inspired me to think of how a digital object could gain additional value based on the experience of two (or more) people being together. A piece that is part of bigger whole was an idea that Jude also explored when she crocheted a number of crocheted balls for her close friends. Related to Jude's craft approach, I created a shared piece of multiple elements amongst two significant others.

The concept of the *Chronos* brooches was inspired by my conceptual thinking around data manipulations as a craft practice. Jude and I started talking about the ways that data can be translated in forms where the encoded message is very personal and idiosyncratic to the individual, instead of simply translating data into another form through an automated process (such as digital looms or 3d printed forms for example). I reasoned that dipping a twig (in this case) into resin in relation to the data of how the *Anthos* brooches were worn could give a craft practitioner the role of an interpreter of the data and use it within the making of a new piece in a less literal manner than would occur with data mapping to a 3D printer for example. Finally, 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 in my design process.

4.9.2.3 Design Development

Figure 4.9-11 Making the *Anthos* Brooches using the same twig. Thinking on how to connect the silver pins with the electronics.

The *Anthos* and *Chronos* brooches are made from the same tree twig (see Figure 4.9-11). The 3D printed part of each *Anthos* piece resembles a flower bud, which has references to time and growth. They are made of a wood filament, which was chosen as a compliment to the twig and a visual contrast to the electronic components that are hosted within each pod. The side of the bud that faces down (when the piece is worn) is open, leaving the electronic components visible (Figure 4.9-12). 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 houses electronic components to expose or reveal them. I wanted to do this in order to propose a form where the aesthetics of the 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, which is echoed in the vulnerability of the components.

Figure 4.9-12 The *Anthos* Brooch. The electronics components remain visible.

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) (Figure 4.9-13). Tommy helped me with the code in first place, however 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 for a beginner in understanding what was taking place and having a more direct understanding of what was happening. For example, (Figure 4.9-13b) shows that when I connected the two wires (to close the electronic circuit), a message *"Brooch is attached"* appeared on the Serial Monitor alongside the date and time when the connection was made. This helped me to test the prototype in a "quick-and-dirty" way.
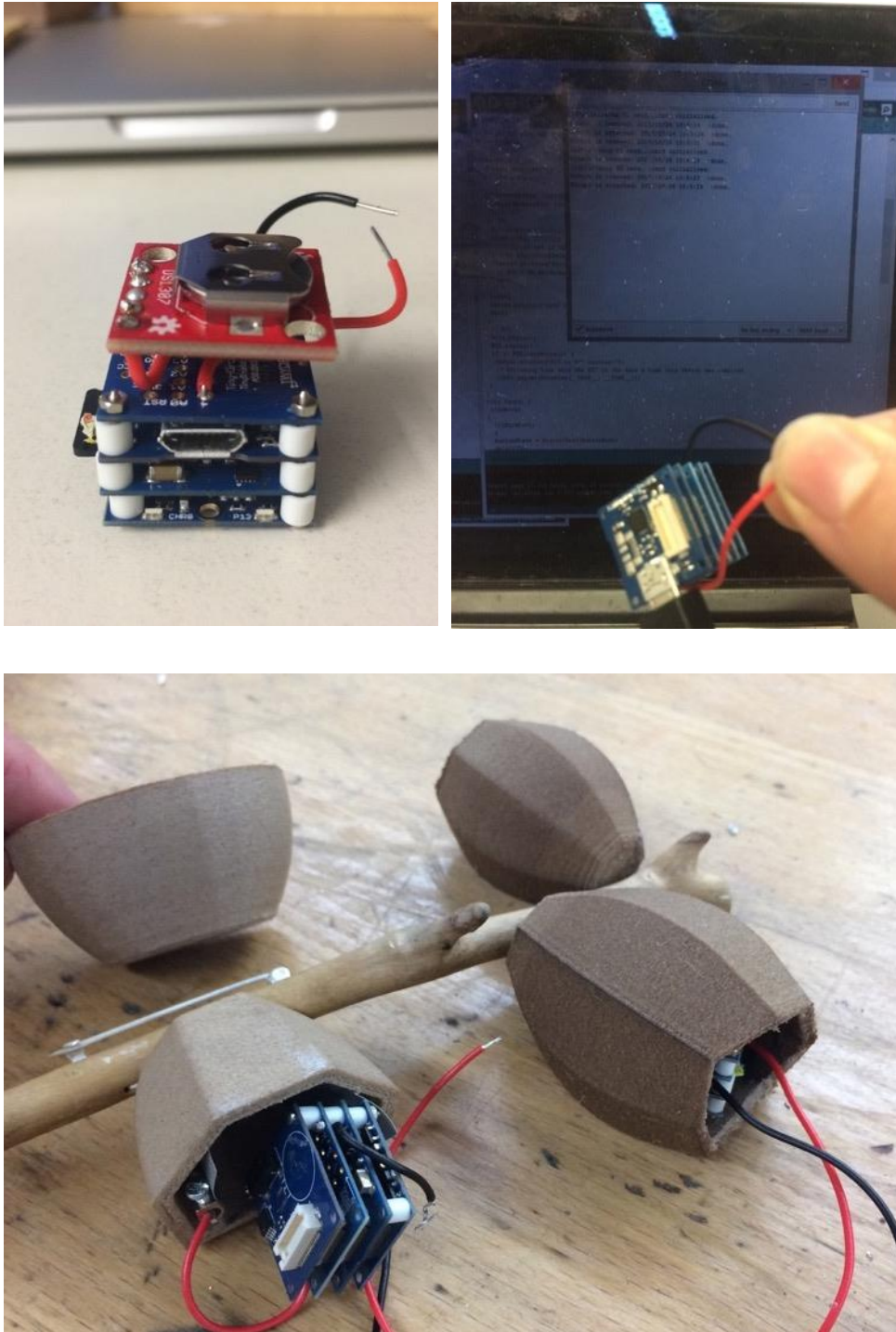
Figure 4.9-13 Working on the *Anthos* Brooches prototype.

(top left) a) TinyDuino boards mounted together from the top: A battery-backed real-time clock (RTC), a Proto Board TinyShield, a USB TinyShield with a TinyShield microSD, a processor with lithium battery support. b) Testing the prototype using the Serial Monitor on the Arduino software.

(bottom) c) Thinking of the form in relation to the size of the electronic components.

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 (see Figure 4.9-14 and Figure 4.9-15). These gentle variations in colour inspired the aesthetics of the *Anthos* brooches. I wanted each *Anthos* brooch to be unique, yet at the same time to be visually part of the same whole. The final forms are similar, but not the same; they have subtle variations in colour (see Figure 4.9-8 p.156).
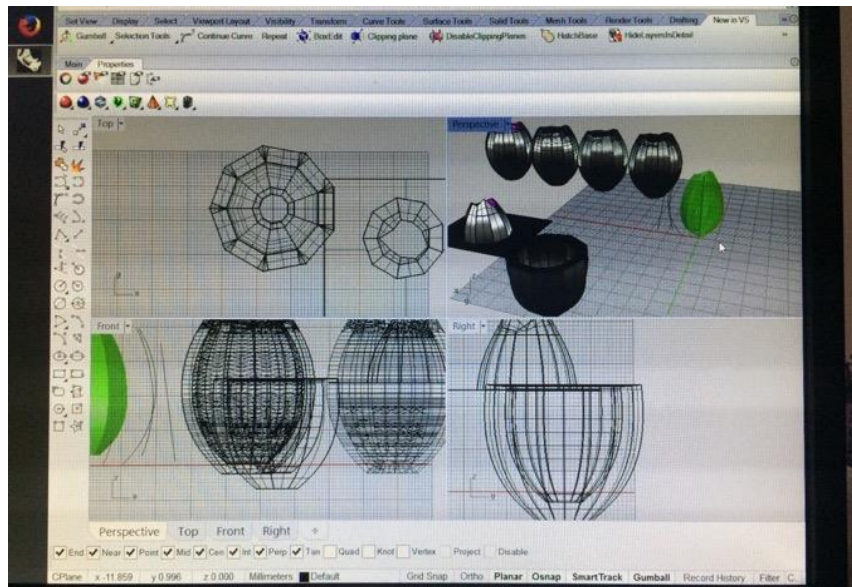
Figure 4.9-14. Designing the *Anthos* Brooches. A screenshot from the 3D modelling software (Rhino 5.0)

Figure 4.9-15 Explorations of the form in relation to the size of the electronic components. 3D printing with wood filament. approx.3cmx5cm.

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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 (see Figure 4.9-13c).

Before I moved on to 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. Figure 4.9-16 shows examples of this experimentation.

In order to create the *Chronos* brooches, I interpreted the data from a pilot study between myself and my mother wearing the Anthos brooches for a week – I was in the UK and she was in Greece. The resulting dipped resin *Chronos* brooches gave us the space to share our interpretations and add a personal interpretative meaning to each ring of colour that had formed. The form of the piece represents change over time through its making. 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. The *Chronos* brooches embody my thinking on how data can be translated into a new form from a craft perspective. I will return to this point in the discussion (see Section 6.1.4 p.213).

Figure 4.9-16 Initial Explorations. Dipping pieces into layers of coloured resin.

4.9.3 Travelling with the Sea
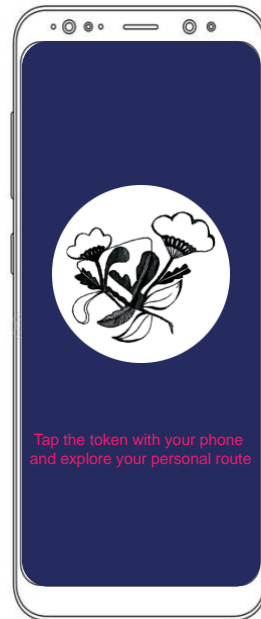
Figure 4.9-17 *Travelling with the Sea* by Nantia Koulidou 2017. Visual Prototype.
Porcelain disk (diameter:3cm), found object, sterling silver, gold powder, mobile
application.

4.9.3.1 Description of the Piece

The *Travelling with the Sea* piece (see Figure 4.9-17) is a purely conceptual piece resulting from discussions and creative working with the participants and also conversations with a creative director working for a British airline. The brooch is an airplane's piece of digital jewellery (an object that will always remain on an airplane, but that passengers can wear and interact with during the flight). It enables a person to connect with stories, people and places (on the ground) from one's current location in the air as one flies over them. This piece incorporates a piece of found ceramics washed up onto a beach (see Figure 4.9-18), which is connected to a porcelain disk with powdered gold. The design on the surface of the new porcelain form includes graphics that takes visual cues from the sea pottery shard. The brooch is supported by a silver frame and a brooch pin.
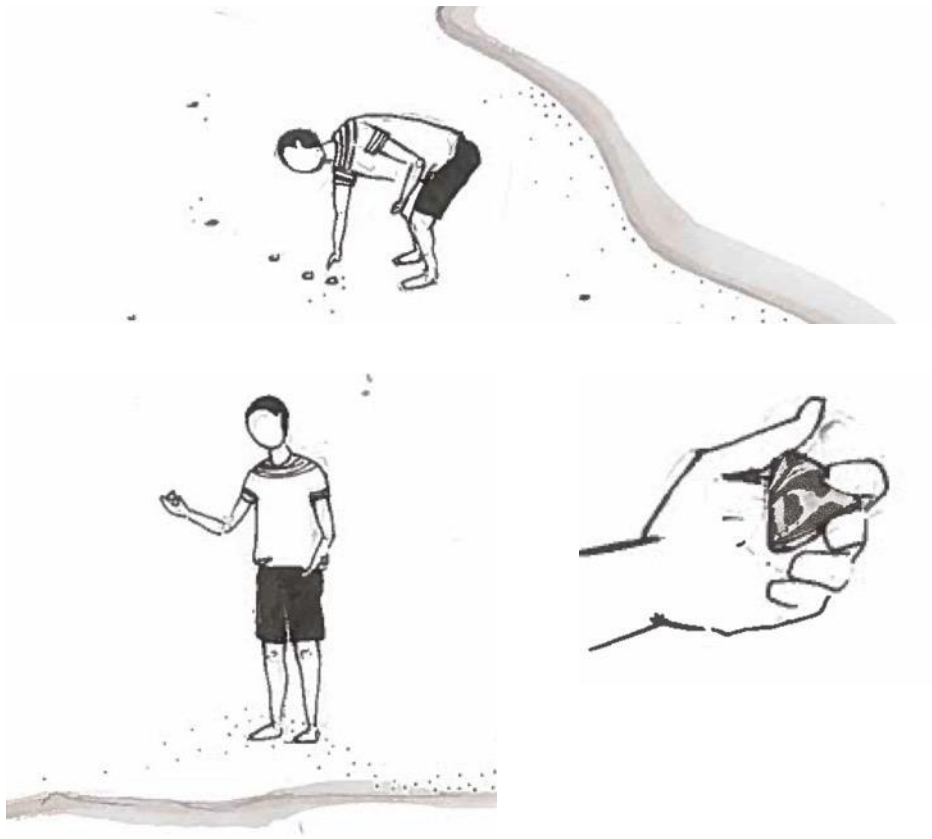
Figure 4.9-18 *Travelling with the Sea* piece. Storyboard

As a plane covers vast distances and passes over countries in a relatively short space of time, the piece is connected to geo-location data and enables a person to tap into data from a location that the plane is passing over. Thus, the brooch acts as an access portal to that specific place (see Figure 4.9-19).

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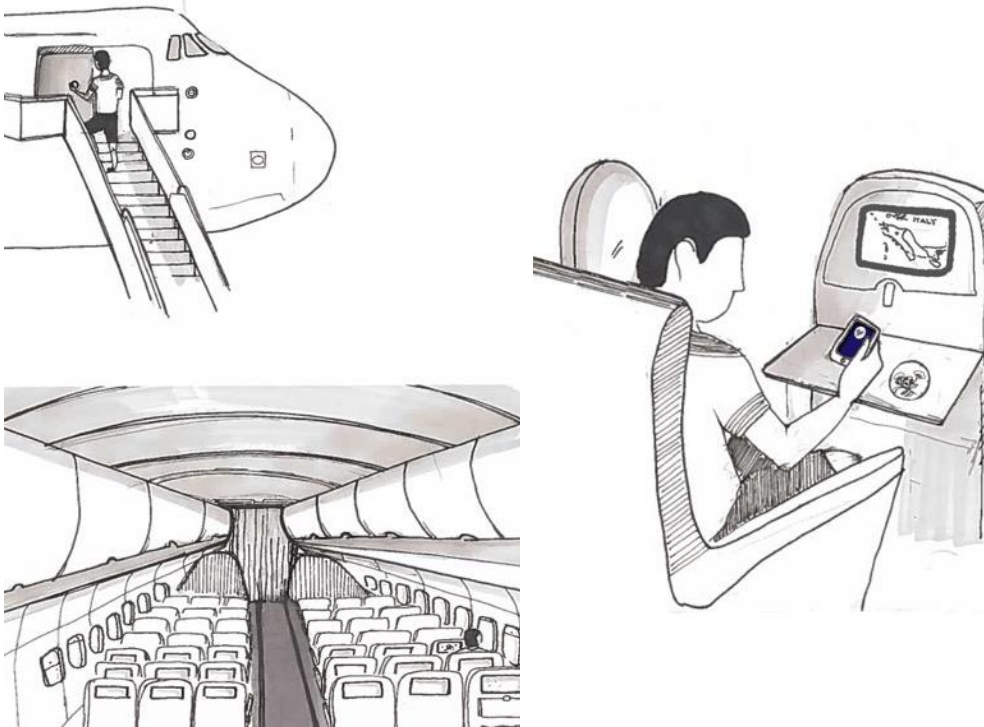
Figure 4.9-19 *Travelling with the Sea* piece. Storyboard

The brooch has a small NFC tag (which stands for near-field communication) that stores information about each specific journey route. The tag communicates with a smart phone via NFC technology when the person taps the object with his/her smart phone. An NFC scanner (on the smart phone) reads the tag (on the piece) and sends a notification message to the *Sea Pottery* app (see Figure 4.9-17) that data is now unlocked. This allows the person to explore the personal route map (see Figure 4.9-20).

The next option is to choose between "Personal Interest" which is linked to data for the place based on a personal interest and "Personal Archive" which is linked to specific data from someone's personal photos from that place. The passenger can explore both connections throughout the flight and filter the search with keywords. For argument's sake, if a person presses the "Personal Interest" button and then types in the word "craft", then he/she can access real-time data such as current craft events/exhibition as well as archival information about the history of art & crafts from this country.

The information gathered can be saved, thereby offering the opportunity for a passenger to map the route on the ground, that one is taking in the air.
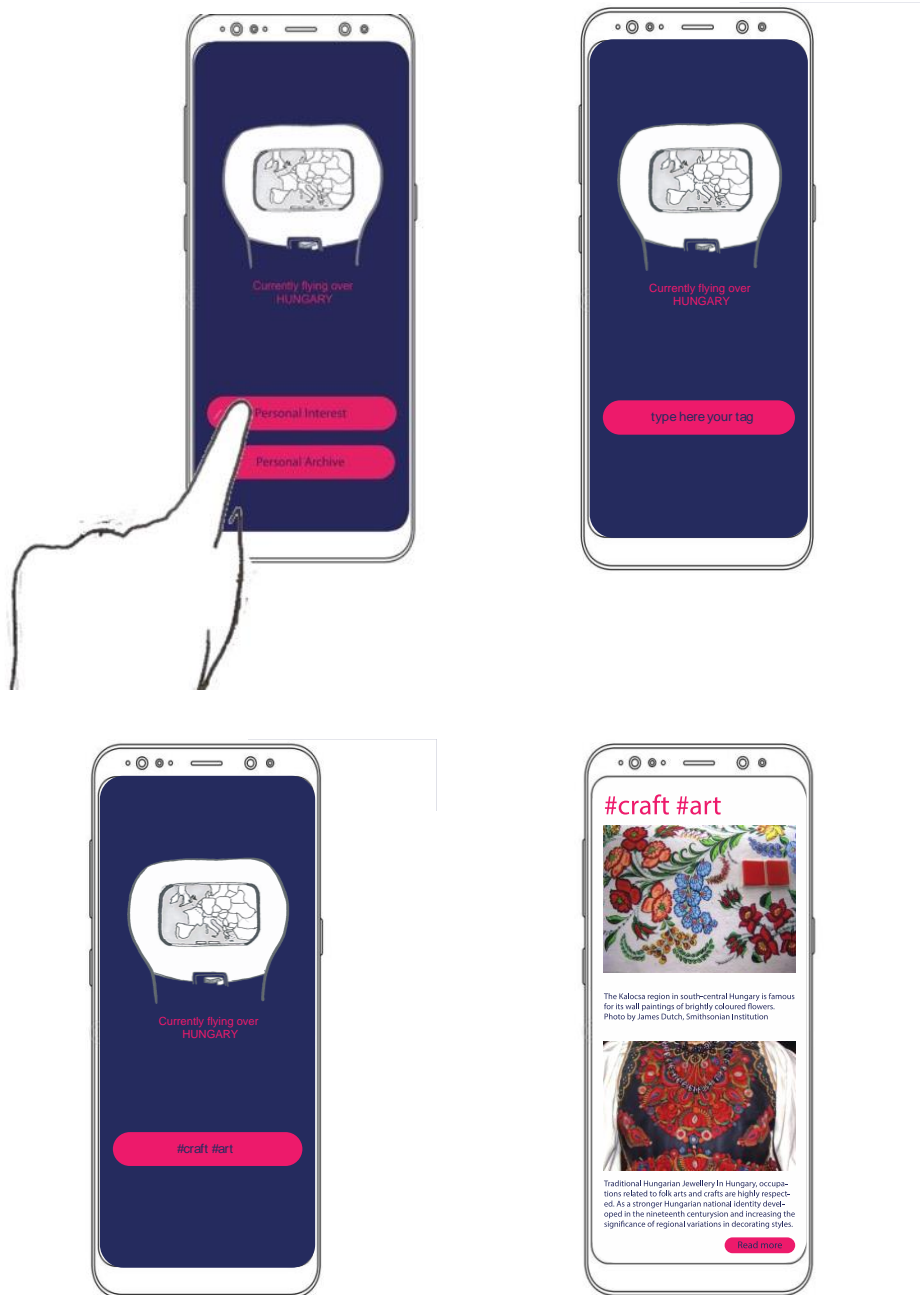
Figure 4.9-20 *Travelling with the Sea* piece. Storyboard.

4.9.3.2 Concept Development

This concept arose from the design engagements (see Section 5.3.4) with all three participants where discussions focused particularly on making use of digital technology in ways where it offers opportunities for them to connect with the current moment and the significance of these connections during micro-transitions.

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Creating opportunities that people can reflect on how they feel in the 'now' can potentially be valuable to how one copes with the shifts in one's sense of self during micro-transitions.

One of the participant's accounts inspired me to think of ways to connect people with their sense of being-in-the-world by imagining a piece of digital jewellery that follows her changing rhythms in life, where the digital could change its context each time and, thus, become a piece that is tailored to a particular experience. The piece was also inspired by discussions with the creative director on ways of connecting a person with geo-location data during the flight, available from where a plane is flying over (see Section 4.6.2 p.123).

Diane's reflections on the "the sea pottery quality" of her objects (see Section 4.8.4) and Jude's reflections on the type of data that she wanted to stay connected with made me think about how a piece of jewellery can act as an access portal to personal data during the flight by offering the opportunity for people to rediscover things about themselves and significant others during the journey.

4.9.3.3 Design Development

Figure 4.9-21a show a collection of objects that I made from a piece of sea pottery and air-drying clay in order to explore different designs and forms. I have chosen the design that I liked the most and started a new set of explorations. I made a section of porcelain disks with the design which I then carved using different engraving techniques and methods (Figure 4.9-21b). Each piece has a hole that allows the found sea pottery to fit within it. This hole is approximately 17% larger than the piece. As I had expected, all the pieces shrank during the firing and changed their appearance in unexpected ways. I chose the disk that resonated my aesthetics and could host the sea pottery piece.

The sea pottery then is connected to the porcelain disk with epoxy and powdered gold. Visually, it resembles the Japanese technique of fixing broken pottery (known as Kintsugi) which Laura and I discussed in one of our meetings. (see p.146). The technique has a variety of styles and joinery techniques, and as a philosophy, Kintsugi treats breakage and repair as part of the history of an object, thereby allowing the object to be part of someone's life for longer. A reference to time is embodied in the piece as part of the object's history. An acceptance of

change as an aspect of human life is also rooted in the Japanese philosophy. These were attributes that were important for me to use as a visual reference. Rather than repairing a piece, in my design I imagined the piece where the broken ceramics piece became a part of a new object with a new use.

Figure 4.9-21 (top) a. Early explorations of the form. (bottom) b. Two examples of porcelain disks with the design which I then carved using an engraving technique. Done in collaboration with Sean Kingsley and Jayne Wallace at DJCAD

4.9.4 Microcosmos

Figure 4.9-22 (top) *Microcosmos* by Nantia Koulidou, 2017. Found objects, sterling silver, velvet fabric, magnifying lens 60x, electronics. 5cmx5cmx3cm

(bottom). Looking through the glass. Photographer: Shiro Inoue.

4.9.4.1 Description of the Piece

Microcosmos is a hand-held piece of digital jewellery (see Figure 4.9-22) 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. 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 that allows 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 it.

As the plane reaches its maximum altitude (approximately 30.000 feet), an LED light inside the piece gradually illuminates allowing the individual to manually focus on the text by moving the slider. Following 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 is beginning to descend (dropping its altitude for landing). Consequently, the light starts fading out, thereby allowing one to view the image one final time for this journey.

4.9.4.2 Concept Development

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 internal to them and being on the plane makes it even more implicit (see more Section 5.3.4 p.197). The participants prefer not to share or show how they feel to others and to enable this they create a personal bubble on their seats by wearing their headphones (Jude), reading books (Laura), wearing sunglasses (Diane). They value the time they have to relax between the practicalities of travelling with check-in and passport controls or migration control on their destination.

An insight from my engagements with the participants and reflections on my own lived experience revealed the significance of a plane as being a space where people can reflect on feelings of transition and recover their sense of self. *Microcosmos* allows one to spend time with oneself and connect with what is personally important, which is potentially of high value during the flight journey. The piece responds to the changes in the environment giving the opportunity for someone to look inside the piece and explore personal feelings of transitions and meaningful connections. This can be supported by one of the participant's reflections (see p.137) that microfilms allow a slow and very careful interaction with personal images that gave her the time to reflect on the meaning of each image.

4.9.4.3 Design Development

Microcosmos is inspired by the Greek words mikròs and kósmos, which mean 'small world'. In literal terms, a microcosm is a world in miniature and metaphorically, the word can be used to describe a small group of significant others. The text depicted on the microfilm (inside the piece) was a text my mother sent to me during the development of the *Space for Emotions* exploration (see Section 4.3.3 , p. 101) which I developed through piloting ideas with her. The text accompanied a photo that pictured a number of photographs from my childhood that my mother sorted out and had put in a specific order. It is a narrative that linked the old photos with my life and some of the emotional challenges I was facing during the research. Whenever I read the text, I think of my mother telling me that everything is going to be alright. Her words were screen-printed on a paper during the explorative phase of the research and, in this stage, the image was inked into film using microfilm technologies (see Figure 4.9-23).

Figure 4.9-24 shows an example of sketches of details of objects I found in a flea market and ideas on how some or aspects of them could be incorporated into the development of my digital jewellery pieces.
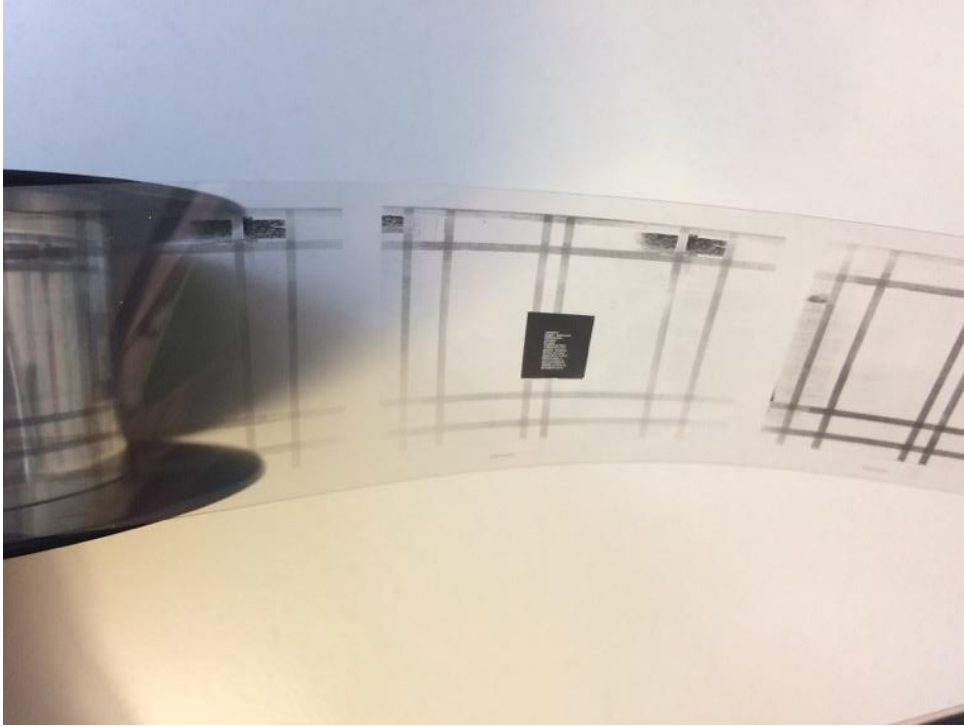
Figure 4.9-23 Microfilm for *Microcosmos*
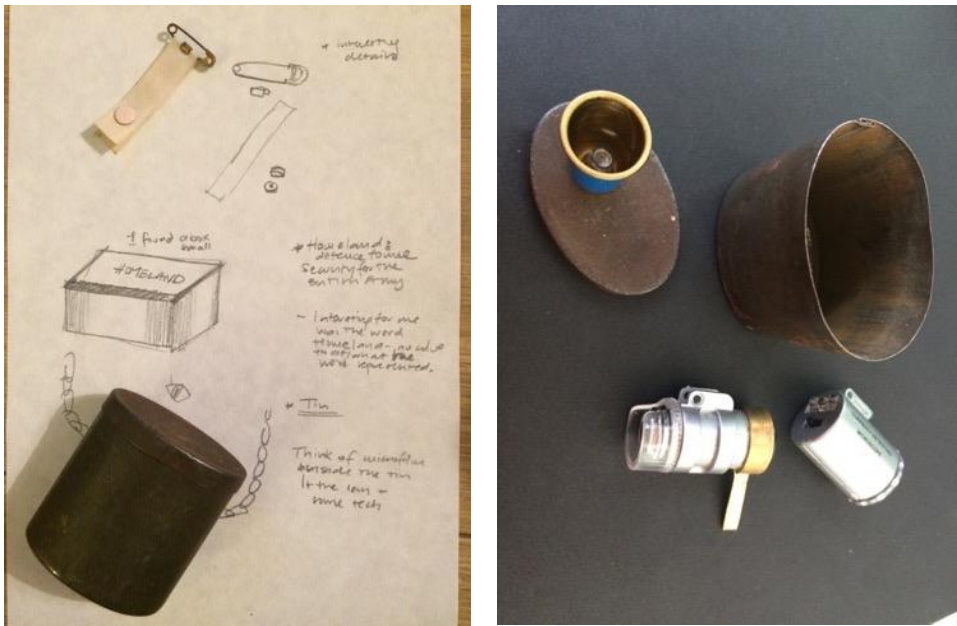
Figure 4.9-24 (left) Inspiration from found objects. (right) Design development of

Microcosmos.

For *Microcosmos* I used a found tin. Its form resembles a film canister (with a lid) widely used in the 1980s for safe, archival storage of 16mm and 35mm film. In my design, the piece holds a microfilm image. The vintage tin was a container that represented something from another decade, which fits well with its use to hold microfilm images. The velvet fabric seals the light thanks to the fabric's light-absorbing qualities, while the handle made of the edge of a found teaspoon invites a person to hold the piece and to explore the interaction. Similar to the piece *Topoi*, the viewing space is made from the edge of a found Stanhope thimble (see p.137).

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 100feet/minute (30m below the sea level) to avoid discomfort for passengers and crew. 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 of 11 000–12 200 m (36 000–40 000 feet), 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). The piece responds to this threshold and the LED illuminates.
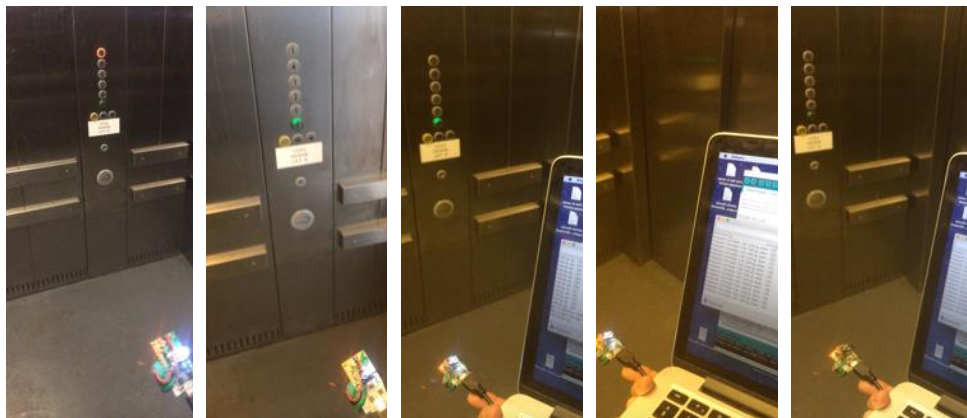
Figure 4.9-25 Testing the prototype in the elevator.

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). Tommy wrote the code for this prototype and I made some 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 40metres (Figure 4.9-25 and Figure 4.9-26). After a few attempts, the light was fading in above a certain height and fading out respectively. For the first prototype I had a number of challenges to make the circuit work consistently on a battery power source (instead of my laptop). We ended up making a new prototype using different electronic components (Teensy board and BMP280 sensor). The battery, the LED light and the push button were the same ones we used for the first prototype. This made me realise that in comparison to working with silver as a material, with electronic components it is easy to "go backwards" and start again. This is often part of the prototyping process. This prototype was taken in an actual flight (see Section 4.9.5 to follow).
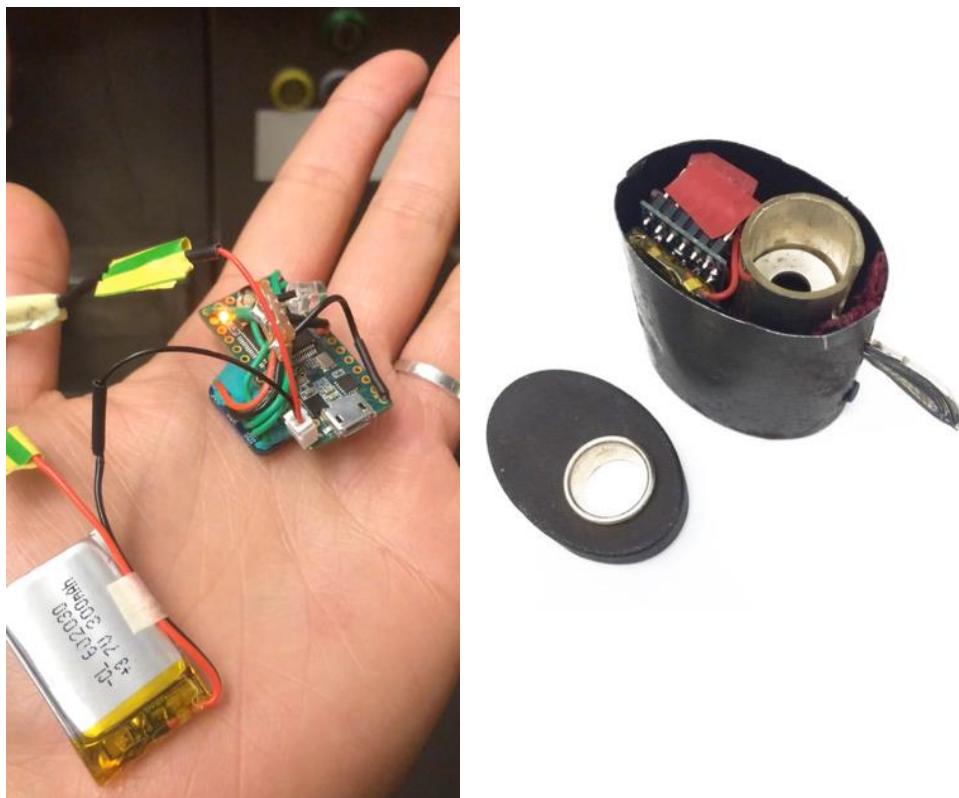
Figure 4.9-26 (left) Electronic components for Microcosmos (right) Looking inside the piece.

4.9.5 In-situ reflections

I felt excitement when I saw the piece coming into life. I was able to view the film during the flight and until the start of landing. I felt anticipation at the start. It was unknown when the piece would be activated. I am wearing the piece inside the pocket on the left top side of my dress. It is comforting. [Personal reflections]

6th of December 2017

I took the piece with me on my next trip to Greece and on the return journey to the UK. On the outbound trip, I left the piece on the seat table and was positively surprised that the piece illuminated 20min after the take-off and switched off approximately 10min after the pilot's announcement that we were ready for landing.

I interacted with the piece a couple of times during the flight and I felt comfort reading the text which made me realise how practical my mother is and how different her perspective of life is from mine. After the announcement that we would soon be landing shortly, I wanted to see the image one more time, because I knew that soon I will not have that opportunity any longer. I anticipated the moment of when the light would fade out, however once this happened in reality, I had a mixture of disappointment and excitement that I was getting closer to home. Suddenly the light switched off. I would have preferred a more gradual interaction. I felt the connection was lost and that was a sad feeling.

26th December 2017

Before my return journey to the UK I changed the duration on the fading time, however I was not sure if the piece would work again. I switched it on at 16:10 and I was in anticipation for a while until the light started illuminating at 16:54. This time the piece got activated 20min later than on the previous flight, yet the moment was even more magical because the light was fading in while we were passing over the clouds. The lights faded out more slowly this time (at around 17:10) and the slowness of the interaction gave me time to accept that this connection would soon be over.

I loved 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.

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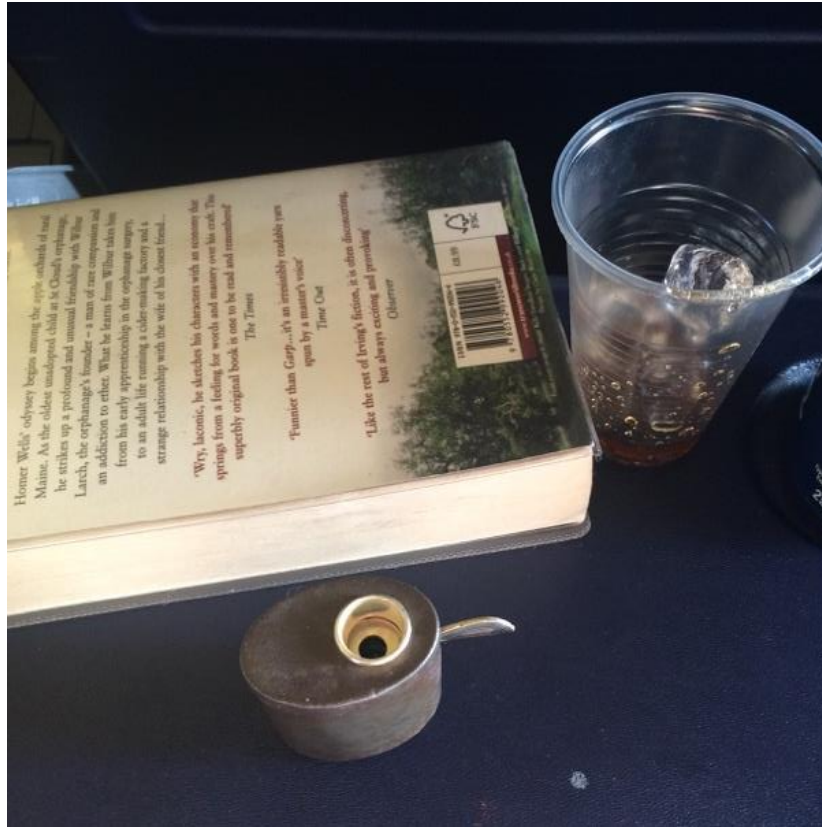
Figure 4.9-27 Taking *Microcosmos* on an actual flight.

4.10 Summary

In this chapter, I presented the explorative part of the work and the participatory engagements with three participants that lasted for two years. From these engagements, I gained insights into feelings and meanings associated with the experience of travelling between two significant places and I identified opportunities for digital jewellery to support this particular experience. Alongside my work with the participants, I had conversations with pilots and a creative director working for a British Airline which added richness to my explorations and thinking. Inspired by my own lived experience, the insights from the design engagement with the participants and conversation with experts in aviation and other practitioners, I designed four digital jewellery pieces that aim to support self through micro-transitions. For each piece, I unpacked the narratives associated with their form and function and I reflected on their concept and design development.

In the next chapter I gathered the insights I have gained throughout the research in relation to digital jewellery, one's sense of self and micro-transitions, home and the creative methods I created for the purpose of the research.

5 Insights

This chapter is divided into two parts.

Part *One* presents insights about digital jewellery which have arisen from reflections from experts in the field and my own reflections. This section also presents insights gained from the research in relation to sense of self in the context of micro-transitions, the idea of home and insights into opportunities for digital jewellery to support sense of self through micro-transitions.

Part *Two* presents insights about the methods that I have designed for the purpose of this research. For the *Staged Atmosphere* I bring together insights into how people experience the environment of the plane and the value of creating probes that are personal and bespoke for participants. For the *Sketching* method I present insights into the value of using sketching in having a visual dialogue around participants' sense of self through micro-transitions.

Part *One*

5.1 Insights about Digital Jewellery from Experts

This section presents key insights for the field of digital jewellery that have arisen from the Delphi method (see more about the method in Section 3.7 p.79). The responses of six experts are woven together into themes that reveal the differences between digital jewellery and wearables as well as the potential of digital jewellery within a wearer's life. This section includes reflections on my pieces and reflections on digital jewellery more broadly. The way in which these insights inform the field of digital jewellery in particular will be discussed later in the thesis (in Chapter 6, Section 6.1.7) where I will discuss a framework for understanding and conceptualising digital jewellery.

The questions that were discussed are outlined below:

Question 1: Digital devices on the body, widely known as wearables, wearable technology and wearable devices are available in the market for some time now and offer a range of applications. What do you think differentiates a wearable device (to use a reference term) from a piece of digital jewellery?

Question 2: What qualities of [these pieces*], if any, do you think are meaningful for digital jewellery?

Togetherness: Anthos & Chronos, Microcosmos, Travelling with the Sea and *Topoi (*see attached DJ for Q2*)* are examples of digital jewellery attentive to a person through micro-transitions. The concepts were inspired by the lives of three participants and myself who all experience shifts to our sense of self that occur during the journeying to and from our country of origin and the country where we happen to be living.

Question 3: What can digital technology do for contemporary jewellery, if anything, that no other technology can?

I turn now to present the insights that collectively strengthen the field of digital jewellery and offer an understanding of the emerging field that may benefit a wider audience of jewellers. (see Appendix B p.253 for full responses).

5.1.1 Features of Digital Jewellery

Digital jewellery is the term used to describe jewellery pieces with digital components and, as four of the respondents (R1, R2, R3, R4) highlighted, it does not appear to be any different from other pieces of jewellery in its use or its purpose. This suggests that digital jewellery, like any other jewellery, adorns the body and communicates socially. Specifically, R3 suggested that digital jewellery, similar to non-digital jewellery, *"often holds emotionally sensitive information and reflects or connects with the wearer's attitude, mindset and personality to others"*. Similarly, R1 said that *"a piece of digital jewellery adorns the body and expresses the wearer's social life and setting"* while R4 noted that digital jewellery has a cultural value *"as a mirror of the time which was created"* and *"[…] it expresses the beliefs, virtues and trials of its wearer"*.

Digital jewellery also has meanings associated with it that can only be understood by its wearer. These features are created over time via the personal stories ascribed in the pieces. Such connections are very personal to the wearer and are *"often intangible and invisible to others"* (R1). Two respondents (R1, R4) agree that digital jewellery, similar to non-digital jewellery, attributes personal meaning to the pieces, collecting insights about the wearers/owners' life through a shared history.

> *Digital or not, a piece of jewellery is a time traveller that collects pieces of insights of its current owner's life […] meaningfulness within digital jewellery grows during the time the piece is owned and there has been a shared history (R1).*

These views indicate that it is the personal connection that makes a piece of digital jewellery meaningful to its wearer.

Within digital jewellery practice, the relationship between the piece and the body is important. For R4, *"the proximity to the body for a long time enables the emotional link between the wearer and a piece to develop, by creating a shared history and developing fidgeting rituals."* Similarly, R5 stated that: *"the term digital aligns itself more closely with the notion perpetuated by contemporary jewellery that an*

object placed on the human body creates a lasting connection between its maker, its wearer and the jewellery object." (R5)

As digital jewellery is pieces that value the idiosyncratic traits and the uniqueness of each person, R6 noted that the wearer's body should be seen as *"a site of self and a very specific canvas and meaningful location for objects"* and not a mechanism from where data can be extracted. R4 suggested that digital jewellery is *human-driven wearables* as opposed to technological-driven wearables. Similarly, R6 highlighted that in digital jewellery: *"forms and technologies can connect a wearer to themselves, to other people, to other places in a huge range of playful, aesthetic, poetic ways"* (R6) and R5 pointed out that in digital jewellery "*technology is incorporated into an object not to provide a functional dimension, but to enhance the connection between its different elements in a poetic, aesthetically coherent, emotionally significant and surprising fashion"*.

These views suggest that the digital offers new opportunities for jewellery practice to expand the social potential of jewellery to connect with ourselves, others and places in personal, meaningful ways. In the emerging field of digital jewellery, technology is not seen as the driver, rather it is a tool that opens up new possibilities for the field of jewellery.

5.1.2 Important Qualities of Digital Jewellery

Two respondents (R1, R4) commented that the Anthos Brooches embodied an interaction (fastening the pin) that is very *jewellery-like* and considered it to be a feature that was desirable. With this interaction, R1 commented that *"the digital became very tangible"* and that was something that she saw as being valuable within digital jewellery practice. R5 noted that:

> *The way in which you have incorporated electronic elements into all four pieces, and particularly [the] subtle switch mechanisms, are a desirable part of the newly emerging practice of digital jewellery and point towards a more integrated, meaningful aesthetic. (R5)*

On the contrary, swiping the *Travelling with the Sea* piece over a smart phone was an interaction that a respondent (R4) found very gadget-like and not a natural interaction in the context of jewellery. When we are designing digital jewellery, we should be aware that familiar interactions with digital objects such as "tapping" or "swiping" will alter how the way in which the piece is perceived. However, we

must also consider that traditional interactions that we would expect to see in jewellery can inform digital jewellery and add value to a piece.

Most of the respondents (R2, R3, R4 and R5) agreed that the aesthetics of the pieces play a key role of distinguishing pieces of digital jewellery from wearable devices. R2 saw value in the material qualities of my digital jewellery and was intrigued by the range of material that I have used in making them (from twig to resin to metal). R4 commented that the pieces are: *"well succeeded in creating a materiality that is suitable for jewellery. The materials (gold, silver), the found objects (bearing the traces of past times) and the recognisable elements like pins and settings contribute to that."*

R4 also commented on the semiotic aspects of the pieces (the spoon-parts, shape, button) of the *Microcosmos* and *Topoi* gave a clue on how to interact with the pieces. The subtle switch mechanism of the *Anthos Brooches* and *Topoi* was an attribute that three of the respondents (R1, R4, R5) highlighted as being a positive step towards a more integrated meaningful aesthetic of digital jewellery. However, R5 commented that the visibility of the electronic components on the *Anthos Brooches* was something that she did not find appealing. R3 suggested that jewellers need to find a coherent visual language that differentiates digital jewellery from devices.

> *The materialisation and aesthetics play a key role of how these communication devices in silver, plastics or printed wood work. I suspect that there is a need for a versatile as well as generic, but always coherent visual and material language, to attract a larger group of people to warm up with the idea that e.g. sensors are valuable and relevant components in jewellery and not just in the field of 'wearable devices' in the future. (R3)*

The integration of form and function was a theme that some respondents commented upon when they reviewed my pieces. R4 and R5 found two of the pieces (*Microcosmos* and *Topoi*) intriguing as pieces of digital jewellery as R5 commented that *"their technological functionality was fully integrated into their conceptual narrative"*. R5 reflected that the interactions with the pieces were sensitive, and that it is easy to see how they could elicit an emotional reaction from their wearer simply via the sense of touch. R4 appreciated the *"conditionality"* of *Microcosmos* and commented that *"the fading in and out of the LED light builds tension and has a subtlety that is very jewellery-like"*. He found it intriguing *"how the digital and the physical merge in the output"* and he commented that *"the dynamic light intensity determines the readability of a [...] text that is unique to the*

wearer". However, R5 agree with R5 who criticised that the *Travelling with Sea* lacked *"a meaningful integration or reciprocal influence"* between the physical and the digital within the object.

Even though R2 and R6 did not described specific qualities of my digital jewellery, their reflections align with the insights gained from the respondents' reflections above.

R2 and R6 agree that there is a great potential of digital jewellery to focus on the wearer's sense of self through focusing on the poetic potential of the form, interaction or functioning of the technology. R2 suggested that:*"Contemporary jewellery can benefit of the addition of digital technology if the intention of the maker is to achieve a goal that incorporates it in harmony with the visual, poetic and functional qualities"*. R6 opined that:

> *There commonly seems to be little focus on the sense of self of the wearer of [wearable] devices in terms of what is personally meaningful to her/him – what would make her/him laugh – poetic potential of the form, interaction or functioning of the technology. This is where digital jewellery seems to separate in ethos from wearable devices (R6).*

These comments indicate that the visual qualities of the pieces are important for digital jewellery. The comments also demonstrate the perceived importance of integrating the physical and digital element of the piece as well as combining meaningfully the function of the piece with its form.

5.1.3 Digital Jewellery Links Explicitly to the Wearer

There is a consensus between all the respondents that digital jewellery is inextricably linked to the person wearing it. Most of the respondents (R1, R2, R3, R4, R5) agree that digital jewellery should be designed to have features that serve a specific person. R1 noted that a digital jewellery may also have features that allow the wearer creates herself/himself. R3 suggested that *"a digital jewellery is (most often) a wearable one-off piece that uses sensors and/or digitally available information for 'a purpose' (as in 'personally meaningful' or 'poetic' or 'useful')"*. He highlighted that digital jewellery *"has no manuals"* of how to use the piece and *"its digital function is often not quantifiable"*.

There is a common language that allows members of the public to understand the functionality of a wearable device that allows people to use them for that

function (for example, a fitness tracker), whereas the functionality of a digital jewellery can best be interpreted by the wearer/owner. A piece of digital jewellery *"have features aimed for the wearer herself"* (R1) and *"is designed and made with the intention to personalise the object for a specific person"* (R2). These views suggest that a digital jewellery becomes meaningful for a person because it offers an interaction that the wearer values. The data that is stored in the piece (or can be accessed in certain conditions) are emotionally charged by the wearer and the interaction with the piece is personally meaningful to the wearer.

One of the respondents (R2) pointed out that in order to design meaningful pieces of digital jewellery for people, jeweller/designer researcher co-creates the pieces with people where the meaning is contrasted through conversations with them. During the participatory design phase, R2 suggested that the *"jeweller/design researcher facilitates the process and the wearer is leading the design"*. This suggests that for designing digital jewellery for personal meaningful experiences, digital jewellery is often co-created with people. As a digital jewellery is often designed for a specific person, it can, therefore, only be evaluated by him/her in its success to offer personal meaningful interactions.

5.1.4 The Technology of Digital Jewellery

Three respondents (R1, R2, R4) agree that one of the main functions of digital jewellery is to hold digital data (images, recordings) which can be accessed in certain conditions. This data can also be stored in the piece. R1 identified that a function of digital jewellery is to act as a key to access data on the cloud or process and transfer data over distance by following the physical path of a piece and its wearer (i.e. location). R3 described more broadly that

"a digital jewellery offers multiple ways of how the 'data' it holds can be read, understood, accessed or used."

For R4, digital jewellery can reach its full potential when *"the data is unique (specific for the environment or the wearer) and dynamic (can change)"*. R4 pointed out that *Topoi* and *Microcosmos* hold data that is unique for the owner and, for *Microcosmos*, unique for the environment of the plane, but that the data is not dynamic (microfilms inside the piece) and thus the piece does not reach the full potential of digital technology. He continued by stating that the *Anthos* Brooches collect unique data of use, however, the 'computing' is not incorporated in the

piece. Rather it is done by the designer who translates the data into the dipping-duration in order to create the new brooches, which embody that *"data is still unique, yet is no longer digital and dynamic"*.

Two of the respondents critiqued the function of *Travelling with the Sea* to unlock data on another device (in this case a smart phone). Using an application in conjunction with a digital jewellery was something that R4 and R5 criticised as being *"a functionality that does not fit with the narrative of jewellery"*. R4 commented that the function of the *Travelling with the Sea* piece, being a carrier of the NFC chip, limits its function to *"act as a key to unlock the digital data on a second object (a cellphone)"*. In this instance, they struggled to see the piece as being digital jewellery.

There is an overlap between interaction design and jewellery in the making of digital jewellery, however certain aspects of the pieces made R5 place *Travelling with the Sea* and *Togetherness* towards the first category. The use of a mobile application on the first piece and the data collection functionality of the second piece tipped them for her into the direction of interaction design.

Alongside the functions of the pieces, respondents shared their opinion on the longevity of the technology. The relationship between a piece of digital jewellery, its wearer and its maker could be long-lasting, however, one respondent (R3) raised the issue that even though *"digital jewellery isn't considered to outdate quickly […] how the technology ages should be an area of our concern"*. R4 also raised his concerns that there are *"implications in terms of materiality, interaction and functionality of the object and in terms of emotional value and time of use"* that makers should take into consideration.

5.1.5 The Function and Purpose of Wearable Technology

There is a consensus between the all the respondents that wearables are technologically driven devices. R3 stated that wearables are *"promoted with the focus on for their technological innovation, new functions and new design features"* (R3). Similarly, R4 opined that "*wearables often tend to have the nature of miniaturized gadgets.* For R1, a wearable device is *"something that helps [her] in my everyday actions, or helps [her] in reaching goals or supports [her] somehow physically*. These views show that technology is the driving force for

wearable research.

R5 stated that *"wearables prioritise functionality over aesthetics, craftsmanship and emotional attachment"*. Similarly, R2 noted that there is *"an unbalanced relationship between the aesthetic of the object, its wearability and the technology embedded in the jewel, to the extent that the technology becomes the most important detail"*. One further issue that R2 and R5 raised is that wearable devices have not been crafted in a workshop or a studio, rather they have normally been developed in the lab by someone with an engineering background.

R5 highlighted that wearables have opened a new way of understanding our bodies through revealing information about its function in ways that were not widely available previously. However, all the respondents expressed their concern that applications of digital technology in wearables are limited to sensing and monitoring our bodily activities and states. R3 argued that the services that wearable devices offer are:

> *Quantifiable ('as measurable') based on the data received by sensors or other means of collecting data. The data has been translated into the defined service, providing the wearer with 'useful/useable' information connected to specialized one-off activities or daily routines. (R3)*

R1, R5 and R6 agree that wearable devices often view the human body as something that can be measured, controlled or medically assisted. R1 opined that *"wearable devices collect information of the body (quantified self) in order to assist the wearer in her goals"*. R5 quoted Bensaude-Vincent to propose that wearables *"align with the heuristic model of viewing the human body as a biological machine, whose essential functionality can be expressed through technological analogies"*. Similarly, R6 summarised that wearables' views of what a body is can *"exist on a spectrum that ranges from being benign to controlling"*. She added to this that:

> *The designers who develop wearable devices commonly view the body as a convenient location for the gathering of bodily data, a pragmatic location useful to distribute technologies that aid in daily logistical activity and as a thing that needs to be medically helped, maintained and supported (R6).*

All respondents agreed that in wearable research, the wearer is often perceived as being a user of a service and, as R2 pointed out, *"wearable devices have a customer, a generic target"*. R3 suggested that we can best understand wearables *"as products with a serial number that has been industrially produced",* as they

offer similar functions to other devices available in the market. Three of the respondents (R1, R3, R5) shared the view that wearables provide the wearer with one or more *"problem solving functions which have been defined and described as functions by the producer (usually a brand)"*. Both R3 and R4 questioned the promoted lure for more and more functionalities that help people understand their physiological self.

From these reflections on the features and functions of wearables, we can learn that wearables limit the scope of discussions that seek to discover significance beyond the practical. Wearables are designed on a large scale as mass produced products and they are driven by functional values. These functions are universal which indicates that a number of people can read the functionality devices and can use them for that function.

5.1.6 Digital Jewellery Aligns with Contemporary Jewellery

Two respondents (R3, R5) agreed that the new and hybrid category of digital jewellery contributes to current discussion within contemporary jewellery on material values and preciousness. R5 goes further to suggest that digital jewellery within the field of contemporary jewellery could take *"the form of encouraging playfulness, eliciting personal emotion, humorous sentiment or abstract conceptual engagement as well as challenging aesthetic perceptions and established material cultures"*. Within a contemporary jewellery framing, R3 suggested that digital jewellery can be made from all materials; from precious to poor. He continued that digital jewellery is free from market constraints and a defined and recognisable aesthetic, which R4 described as being an important attribute in the new field of digital jewellery. More specifically, R5 commented on my digital jewellery as: *"[...] examples of how digital jewellery as a discipline could grow to incorporate meaningful interactions and conceptual narrative through the medium of digital technologies, while allowing room for the artistic voice of the individual practitioner to emerge."*

Two respondents (R1, R2) critiqued that the examples of digital jewellery presented in the thesis do not reveal the real connection between the wearer and the piece because they have not been worn by anyone, and thus neither have become part of a wearer's life. However, two respondents (R3, R5) commented on the

pieces from the perspective of a jeweller/researcher who are trying themselves to identify the potential of digital jewellery in people's lives, leaving aside the fact the pieces were not designed for a specific wearer. They read the pieces based on their materiality, their interaction with the body and the integration between digital and physical, which revealed a number of insights for the future of digital jewellery (see more on the discussion chapter section 6.1.7 p.217).

By placing digital jewellery within contemporary jewellery practice, the importance of digital jewellery lies in its conceptual framing, rather than its relationship with a specific wearer. Digital jewellery could be, for example, a commentary on existing conceptions of digital technologies in our lives, revealing a rich conceptual space for design interactions with digital objects that are personal and intriguing.

5.1.7 Making Digital Jewellery

Four of the respondents agreed that digital technology is another material in the maker's toolbox (R1, R2, R3, R4) and more specifically R1 suggested that the *"digital features should not be seen as different from any other features (ie. enamel, engravings or gems)"* of making jewellery. R2 added to this that digital technology can be seen as being an attribute *"that enhances, challenges and pushes forward the boundaries of contemporary jewellery as it offers a number of possibilities that are new to the field."*

One respondent, R6, suggested that *"digital jewellery is pieces made by jewellers and their approach to the body is fundamentally different to non-jewellers"*. However, other respondents (R2, R3, R4) highlighted that making digital jewellery is challenging in itself for jewellers as it requires a wider set of skills. These respondents agreed that the field of wearables and digital jewellery involves a range of disciplines from interaction designers, service designers and jewellers. More specifically, R4 commented that digital technology *"has become too complex for jewellers to fully master on their own"* and suggested that *"for more complex systems, cooperation with experts, is needed"*. He outlined three main technical difficulties that arise in working with digital as a material: *"the size of the electronic components, the durability and the power source"*. R4 continued by suggesting that each discipline can share its point of view and *"cherish each other's qualities"* to develop examples of digital jewellery pieces with more complex data manipulations.

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Such collaborations could benefit jewellers not only at a technical level, but also at a conceptual level. The implications of this are that jewellers can include digital technology in their thinking when designing new pieces because they have an understanding of the qualities of this material.

5.2 Insights about Making Digital Jewellery

This section points out what I have learned from working with the digital as a material within my practice. Within the field of contemporary jewellery, jewellers have used textiles, paper, found objects alongside more traditional materials such as metal or gemstones to express personal, societal and political concerns, however working with electronics as a material for jewellery practices brings a number of challenges that are new to the field. The themes I have identified and will describe are (1) making digital jewellery is prototyping (2) physical manipulation of electronic components (3) qualities of the digital as a material.

5.2.1 Making Digital Jewellery is Prototyping

Making digital jewellery is a prototyping process, which means that it is an iterative process of working together with form and function. Often a number of prototypes are necessary to achieve the desirable interaction and find the synergy between form, function and interaction.

1. Make a visual prototype for the form and a prototype for the interaction. Combine them in the next stages of making.

2. The scale of the piece.

3. Think of the conductivity of the materials.

- compromise
- jewellery

jewellery

concept for DJ

develop an understanding of the qualities of the digital as a material in a practical level and its potential role in a conceptual level

prototyping

- compromise
- technology

1. Use existing electronic circuits to test the concept.

2. Use simple tech for complex tasks.

3. Learn how to make the simple things work.

4. Make Video prototyping to test ideas.

5. Have ongoing conversations with a creative technologist.

Figure 5.2-1 Making digital jewellery is a prototyping process. In order to explore concepts in the first stages of the process, it is necessary to make some compromises both in form and interaction.

5.2.2 Physical Manipulation of Electronic Components

The meaning of the electronics is on the interaction and not on the material per se, however, we have to take the physicality of electronics in consideration and work along with the challenges that they bring in terms of selection of the components, the size of the prototype and power source.

Components: Printed boards, soft sensors or flexible structure are available; however, they are often useful in later stages of prototyping when the concept and interaction are more defined. Typically, the prototyping process starts with square and fixed hard surfaces. A variety of boards with built-up hardware (i.e. different sensors) are currently available to make prototyping easier in a number of ways. Depending on the concept and the desirable interactive qualities of the piece, the maker can select the board that is most appropriate to start with. It is important to discuss the available boards in the market with a creative technologist at the early

stages of the prototyping. Tommy (the creative technologist who supported my work) had the expertise to guide me in certain directions which was valuable and saved me a lot of time.

Size: In the first phases of the prototyping process, makers might need to consider the scale of the prototype and bear in mind that downsizing a prototype can be both very challenging and time-consuming. This became clear to me during the making of *My Personal North* piece (see p.105). The making of the digital compass was very challenging and involved a long process of trial and error. My attempt to make a small prototype was not possible in the timescale that I had. For this first prototype, the combination of the materials and the form of the piece did not have the sensitivities that I wanted. A digital jewellery has beauty due to the meaning associated with the material (traditional and digital), however this prototype did not have a synergy between form and function and (at this stage) I do not consider it as piece of digital jewellery. This process helped me to realise that working on the aesthetics of interaction should go alongside the aesthetics of the piece. I applied this thinking to the making of other digital jewellery pieces.

Power source: It is important to consider the power source from the beginning of the making process. In the making of *Microcosmos*, I faced difficulties when I moved from the laptop to a portable power source. In the piece *Togetherness*, I faced the challenge to make the battery last for longer than a day.

5.2.3 Working with the Digital as a Material

In comparison to working with silver as a material, with electronic components it is easy to "go backwards" and start again. This is often part of the prototyping process. When a piece of jewellery is made out of silver it is often possible to melt the piece and start all over again, however this is often time consuming and expensive; this is not the case with electronic components. This insight became clear to me when Tommy rebuilt the electronics for the piece *Microcosmos* (see p.173). He used some of the existing components, but a different board (compatible with Arduino software) and a different sensor before uploading the same code on the board.

Making the process more visual for the practitioner is an important part of working with the digital as a material. It is important to break down the interaction into bits and work around them. Different from ceramics or silver, the

responsiveness of electronics is less visual. When the interactive system does not work, making the process visible is necessary in order to check where the problem is. In the software, lines of code known as "debuggers" can be added to communicate with the hardware in order to check which is the part that gives an error.

5.3 Insights about Short-term Micro-transitions and Digital Jewellery

5.3.1 The Idea of Home

The written narratives of the participants, the probes themselves, the discussion at the airport and the reflection on the *Compass of Ourselves* probe (p. 144) all brought valuable insights into how people feel about their home of origin. Participants discussed their sense of home and explored it through these activities.

Laura's sense of home and belonging is not static and anchored to a specific location, rather it is dynamic and evolving. Laura reflected on how her feelings of home have changed over time:

> *There was a time in which I would lose my sleep for fear of coming back to "Europe", that was more than 20 years ago. Now, I lose my sleep with the fear of going back to South America. [Argentina] (Fictional place) is not familiar anymore, at least not as much, it does not feel safe [Laura].*

When Laura visits her country of origin, she has a mixture of feelings. She talked about pleasant and unpleasant feelings, *"because there are so many moments that you feel this is home and others that you don't know anymore"*. The smell of the sea connects her with pleasant memories of home. The sea was the place where she felt reassured in her home country; now her place of comfort is the Highlands of Scotland, *"a sea of mountains, where [she] go[es] to feel smaller than nowhere, smaller that the inevitable parts of life"* [Laura]. Jude experiences similar feelings with Laura and what home means to her is not clearly defined. Throughout the study, Jude reflected on her feelings that there are *"more than one homes for her to be made and lived"*. More than just a place, home is a feeling and

it is always about people; her family and friends. In her words: *"I think the most important part of home is my parents. Without them being "home" to Germany, I wouldn't feel the same and I'm not sure I'd consider it home. [I could consider it] as visiting Germany"* [Jude].

Diane feels strongly connected to both places (her home of origin and her current home). Diane reflected that the drawing captured well how partitioned her life feels; parts of herself are in both places, and she never feels complete. She talked extensively about a city and described it as her *"fantasy place"*. It is the place that she visits occasionally. She has her *"must go to"* places that she treasures in each city and she loves being recognised by acquaintances and strangers (shop staff, waiters etc). This makes her feel as though she belongs.

5.3.2 Sense of Self though Short-term Micro-transitions

The accounts of all three participants indicate that the experience of living in/between two countries can take different forms. Each participant emphasises different dimensions of the experience and evokes different meanings for the individual and for each journey between the two countries. Diane experiences this transition as a period of gradual disconnection and reconnection to something familiar when she experiences feelings of homesickness and disorientation. For the first few days in Diane's trip she is constantly adjusting to the places, people and things that are familiar to her in her present location. However, Jude's account of her experience of travelling home can be very different. She described that how she feels is dependent on where she is in her life and what is happening to friends and family in both places. She presented herself as being *"constantly shifting, like a coral moving with the streams of an ocean"*. Laura's reflections communicate a strong sense of self, however, travelling back to her home country is an ongoing challenge *"to meet the different"* when feelings of home and notions of identity are floating every now and then, slowly appearing and disappearing in her thoughts. These feelings are more noticeable on the journey itself. Although the three women described very personal ways of engaging with their situations, they all shared a sense of self that is floating, shifting and adjusting to the changes, which I describe as 'being in-between'.

The women described feelings of anxiety and discomfort because they had little or no control over all these transitions. The following quotes capture this well:

[Transitions] happens over time, it is kind of waiting to arrive somewhere.
I guess you can decide when it starts; it doesn't start when you are on the
plane, it starts when you decide. It could be when you are on the plane, it
could be when you buy your ticket or when you arrive [Jude].

Sometimes I have no control over these transitions, that there is no starting
point or end. There is no aim, no place to go really, things change just
move like in this clock, slowly and sometimes without realising the change
[Laura].

Diane feels disorientated and confused for one to two days after her arrival: *"I always have a weird moment when I arrive – I am always desperately homesick for my "other home""* [Diane], however, this passes and then she never wants to leave once she is settled in. During the journey itself, she feels disorientated and disconnected; a sense of being lost: *"When I am in the air, I know no one can contact me. I feel delightfully irresponsible, but also afraid that something could happen and I would not know for hours"* [Diane]

5.3.3 The Timing of Micro-transitions

Participants found it hard to reflect on transitions that are not happening right now. Different types of transitions happen in life at the same time. During the two years of our collaboration, participants went through different transitions in life; family difficulties, moving cities, finding a new job, or buying a new house. Even though we were in dialogue to conceptualise ideas on digital jewellery for the example of the transition of going back home, finding the space and time for these conversations was challenging.

The *Air[craft] workshop* was organised in December, a few weeks before participants' scheduled trips back to their home countries. This was a dynamic I did not consider at the time, however in reflection I see it as being important, because the workshop was connected with the actual experience of travelling home for Christmas. Similarly, reflecting on my conversation with Jude in the train journey back to Newcastle, it was easy for her to share feelings of moving to a new city and the challenges of her situation of living between two cities, however she found it very challenging to talk about her experience of visiting her home country. Thus, in order to study micro-transitions, they have to be current.

Another finding from the research is related to the temporary nature of micro-

transitions. The feeling of being in-between does not last therefore micro-transitions are transient and fleeting. I found out that capturing the feelings and meanings associated with micro-transitional experiences is important when designers are aiming to gain rich insights into these experiences.

5.3.4 Digital Jewellery and Personal Meaning

In this research I have identified opportunities for digital jewellery objects based on two types of *in-between* connections, which I am terming the *horizontal* and the *vertical.* The horizontal connection refers to the emotional connection between people, which is often symbolised through places and objects (in/from both countries). The horizontal also connects one person and a significant other who are in two separate locations in non-direct ways. The vertical connection brings the focus to the current moment during the transition (i.e. period of travel) and the reflections of the sense of self in the 'now'. In Figure 5.3-1 I summarise both types of connection.
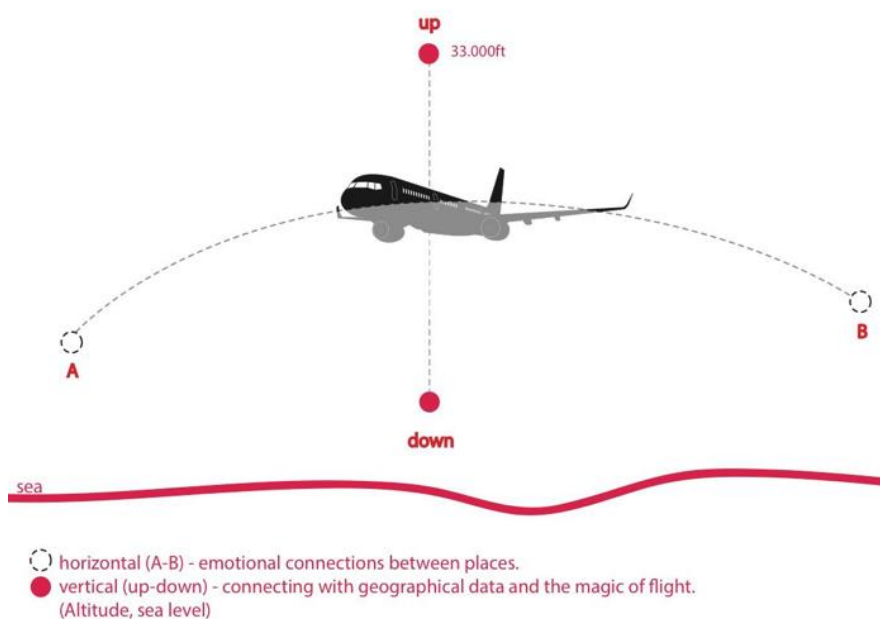
Figure 5.3-1 Types of connection that could potentially support self during micro-transitions.

Drawing upon the participant's reflections, I present four insights that are opportunities to develop digital jewellery in order to support micro-transitions.

1. Digital Jewellery could help individuals to connect with significant anchor points to allow the individual to cope with the transition itself. Anchor points from the two locations that help constitute a micro-transition can support this process by connecting the participant with their sense of longing and empower the participant. This is important in periods of micro-transition where one's sense of self is messy and uncertain. The value of these anchor points is that they can support one's emotional wellbeing through offering a personal bubble; a safe space to be. During the explorative workshop, Diane reflected on the significance of a wedding photo album that includes portraits of significant others in both places. She commented that the album is very special to her because it has everyone she loves, and that *"everything else is always separate in her life"*. Jude imagined a piece that could hold meanings from both places could potentially support her transition. Jude's piece would incorporate little parts of what home means to her, *"like a coin with two sides"*; the piece's two sides could represent her two homes, one in Germany and one in the UK.

2. Digital Jewellery could help individuals connect with significant others indirectly to act as ice-breakers within the relationship. People act in unique ways before and during the flight that allows them to connect with their family at home, often in indirect ways. Participants suggested that these activities are intended to be talking points for conversation. Laura shared with me that sometimes during the flights she reads *The Economist*. Her dad is an economist and always has the magazine at home; reading the magazine keeps Laura connected with her dad and it is her way into a conversation with him when they meet. Jude reflected on crocheting and knitting during the flight:

> *When I go home for the Christmas holiday (which is often the case), I often bring some wool & crochet hooks to crochet during the flight. It's something I have learnt from my grandmother and my mum, and I also bond over. We would usually share the newest creations via skype and go to buy wool together in the local craft/ wool shop when we meet. [Jude].*

Jude's and Laura's reflections inspired me to think of ways to connect people during the micro-transition by making me think of the digital in ways that are non-intrusive in an environment where digital technology is often intrusive and direct. When I presented the sea pottery pieces to Laura, she *"felt like putting them together again"*. Laura talked about the Japanese technique of fixing broken

pottery, known as Kintsugi. She commented on the pieces as parts of other times and she suggested that a piece that could connect her with the present moment in her life would be of a greater significance to her. Members of her close family could have parts of the same piece and when the pieces are in the same location then a new function could be activated. She suggested that a new piece, which is created when people are being together, allows access to another function, thereby gaining a different value and characteristics from the initial found piece. A piece that is part of bigger whole was an idea that Jude also explored where she knitted a number of crochet balls for her close friends. She gave a piece to each friend and shared a picture of all the crochet balls with each of them. She wanted them to feel part of a larger whole.

3. Digital Jewellery could help individuals control physical elements of the experience during a micro-transition which acts to reassure the individual and give them agency in situations where their agency is often limited. In micro-transitions, our ability to control our immediate environment is often limited. Objects that help individuals control their personal environment are important in micro-transitions. Diane shared in her reflections that holding the ceramic piece gave her a feeling of reassurance, when a lot of things are shifting and changing. She described a similar feeling when she squeezes her rings in her hand. Jude reflected that her variation of her piece was too big for her hand and that she would have liked a smaller piece (like Diane's) because holding something in her palm brings her comfort, for example a "Handschmeichler", which in loose translation means a smooth peddle fitting nicely into the palm. Diane's and Jude's reflections made me think of a digital jewellery that could fit within the palm which can give them a bit of control over these transitions.

4. Digital Jewellery could create opportunities for personal and private time that is valued by individuals during the flight. The physical aspects of micro-transition (being in the air as well as being around strangers in a confined space) was something that the participants picked up on in their reflections. The plane is a space with unique characteristics. The temperature will rise before the take-off, the altitude will change as we pass over countries in acceleration and the sound of the engine will accompany our thoughts during the flight. The weather above the clouds is different from the weather on the ground. *"There it's sunny up there and when you land is grey again. So strange. Difference in when it's sunny above the clouds and when you get down is grey. I find it so weird"* [Diane].

In the plane, creating one's personal space was highly valued by the

participants. Jude reflected that she finds her personal space when she wears her headphones (even when she is not listening to music), Laura brings some books with her, and Diane wears her sunglasses during the flight to find the space so that she can be with herself. Laura highlighted that:

> *...anything that happens on a plane is very internal, more internal than usual [...] If I am on the plane, I am in my own bubble. I might want to talk to someone, but usually I might keep it to myself and not talk to anyone [Laura].*

Sitting in a plane, Diane is able to recover her sense of self.

> *There are different feelings there are different status. At the airport when you checked in and all your bags are ready and you don't need to do anything and you sit at the bar and you watch the planes, and you say I'm here now and even more when you're in your seat in the plane in you stored your bags in the inner seats. There are these relaxing points during the journey [Diane].*

The invitation to whisper a thought or record their reflections in an audio recorder was not something the participants were engaged with. I considered the nature of audio and another people's ability to hear what you are saying to be something that is not considered to be private in the context of a plane. However, hiding small notes in the holes of the ceramic *Untitled probe* was an interaction that participants described as being both personal and intimate. This finding was also realised through the interaction with the *Parts of Me* probe, which invited participants to explore various ways of interacting with personal information in the context of the plane. Even though personal information was hidden in the interpretation of the images, all three women reflected that revealing parts of "other selves" in the interaction with their body made them realise that bringing someone else's personal aspects closer to one's body felt uncomfortable, especially in the environment of a plane, where personal space and privacy are highly valued.

> *Although I am quite open talking about a lot of things, when it comes to real emotions I keep them to myself, especially in public spaces such as an airplane. For me any transitions and transitional thoughts and feelings are happening internally, and I would not want to share these in obvious ways with strangers around me. A flight home is such a public event which stands opposite to the privacy of feeling about home or transition. The enforced closeness of strangers on flights can make this additionally uncomfortable. [Jude]*

5. Digital Jewellery could create a space for reflection. Finding the time for reflection is valuable during a micro-transition because it allows people to connect with their sense of being-in-the-world and their current situation.

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During our meeting, Jude and I discussed an idea for a sea pottery piece that connects with a second piece and acts as key to unlock a function. For example, the piece could be a lamp switch or a trigger for an audio tune when she arrives home. Jude critiqued this view of *"a piece that completes another one"*, as it offered a narrow view of what digital could be in this context and she invited us to look at a sea pottery piece *"not actually like a piece of another thing, but as fragments of something else that forms a new identity"* [Jude]. Jude kept a piece of sea pottery in her pocket for a couple of weeks and reflected on how the piece made her feel comfort as it is was changing in colour; taking the blue colour from her jeans (see Figure 4.8-9 p.147). The piece made her think of what home means to her, especially during the time that she was moving to a new city. She imagined a digital piece that she could wear and/or change over time as part of her daily life. The digital could change its context each time she wears the piece and, thus become a piece that is unique to her because it follows her rhythms in life.

Connecting with the "now" moment was something that came out from my conversation with the creative director at an airline, which helped me to think of the significance of the connection with data from the ground where one is flying over during a flight.

Responses from design engagements with the *Compass of Ourselves probe* revealed that notions of home and belonging are not static and anchored to a specific place, rather they are dynamic and evolving. Jude and Laura were looking for opportunities that could allow them to reflect on the changing rhythms of their life and, thus take some control over these transitions.

> *For me, in a way the compass has more than one needle, to show that is not just one direction, one way to go through life, with the many different ways, or traces, you can go this way and that might lead to different directions [...] I could play with the magnet and the compass and see how do all these fit together in my messy head. [Jude].*

Participants' responses suggested that thinking of anchoring an object to towards a specific location was not something they were engaged with. They collectively revealed the significance for a reflective space during a micro-transition where a person has the opportunity to connect with her/his sense of being-in-the-world. The digital can support more ambiguous interactions that one has to make sense of based on what is happening in her/his life at the current moment.

Part *Two*

5.4 Insights about Staged Atmosphere

5.4.1 Authentic Environment

The *Air[craft] workshop* offered a fictitious space for the participants to explore how experiences of travelling home affects their sense of self in a physical, emotional and social dimension. In the space between reality and fiction, participants found themselves comfortable to share their reflections. I used the method of role-playing to create an immersive environment where participants could reflect on their feelings in the context. The sound of an aircraft taking off and landing and the sound of the announcements machine enriched the theatrical space. The announcements using the onboard PA system structured the workshop, through creating the space for exploring the various design probes in a performative way. Being on the plane was stimulating for the participants. The following quotes capture some of their reflections:

> *It really worked for me. When you said - we are ready to take off - and we hear the taking off. I felt the same as I am feeling when I fly, the anxiety on the stomach, the excitement. [Diane]*

> *The plane surrounding really helped. I was able to forget that we are not taking off […] So it did feel the same to me, definitely... being inside the plane really helped me imagining. [Jude]*

Liminal spaces, such as planes, airports and trains have unique characteristics as spaces between destination and arrival that allow someone to reflect on feelings of being in-between. There is a potential within design practice to consider liminal spaces as being contexts where people can share aspects of their sense of self that can be insightful and inspirational for design. In this respect, when design researchers aim to gain a rich understanding of how a transitional experience affects the sense of self in context, they should consider the liminal spaces as the

design activity is being introduced as it can stimulate feelings and emotions of the actual experience that would not be possible otherwise.

5.4.2 Crafting the Design Probes

Working with a set of probes during the *Air[craft] workshop*, I gave a variety of options to participants to pick and interact with the objects that they felt more comfortable with. As I expected, the different probe objects that drew the attention of the participants were the probes that were the most engaging to reflect on their sense of self during the transition. The probes in relation to the body *(Chew of Familiarity, Parts of Me and Unknown ceramics probe)* proved to be an important trigger in the narration of each participant's individual story. These probes played a significant role in stirring reflections on the participants' experiences of being in an in-between state. I suggest that to gain an understanding on how a certain situation affect one's sense of self, it is worth considering probes that can be worn on the body or fit on the body so people can respond to their physicality.

In the making of the probes, I was concerned with a framework for designing the probes (see more in Section 3.3.2 p.60). I wanted the probes to feel considered, skilfully made and beautiful, but to still leave a level of unfinished element that left space for their reflections and interaction with the artefacts during the workshop. For the *Neither Here nor There* probe, participants had to place the flight ticket to start the interaction, for the *Parts of Me* probe they had to interact with their body, and for the *Unknown piece*s, I presented an odd combination of objects that invited participants to explore its form and interaction. With the *Parts of Me and You* probe, I introduced an atypical visual dialogue with the participants by sharing sensitive and intimate issues in a way that is imaginative and non-descriptive. The pictures had an open-ended interpretation.

I saw the hand-crafted qualities of the probes as an asset to open up spaces for participants to reflect on aspects of self and explore what is personally meaningful in the context. By removing the bark from the stick for the *Unknown known*, the crochet embroidery hoop used in the *Parts of Me probe* suggested a slow creative process of making the objects. Some of the probes were bespoke for each participant and that was an element that the participants valued. They asked me if it was possible to take some of them home. Working with craft practices and various materials there was something I conveyed by valuing each participant. This relationship enriched the role of probes to offer a dialogue (see Section 3.3).

5.5 Insights about Dialogical Sketching

In my exploration of designing forms of creative engagement to support a dialogue between myself and the participants, I used sketching as a visual method to explore aspects of self. For all the participants, the sketches acted as *tickets to talk* (Sacks, 1992) in supporting new conversations about the past and the current moment. While researching aspects of self is inherently challenging, the series of sketched probes provided a way to engage people in imaginative ways. In a visual dialogue that was open to interpretation, I was able capture layers of personal meaning and share them with the participants, and then in turn they could share their sketched responses with me. This provided alternative ways for participants to find their voice in the study that are sensitive to the context.

5.5.1 Non-descriptive Method and Interpretation

One goal of the research was to gain a clearer understanding of how the participant felt when adjusting to their sense of self depending on which country and 'home' they were in. Through sketching, we were able to approach this through gentle and imaginative means. Each participant saw elements of the sketches that had meaning to them or could be interpreted in personal ways. They shared images with me that were personally significant to them – but that I never knew the full meaning of. Many of the personal aspects of the sketches could be best understood by the participants themselves. This was a dynamic that I was happy with. As in any dialogue, not all inferences are known by all parties and this is not the aim of my approach. Many parts of the drawings were purposefully left undefined, unless the participants felt comfortable to share aspects of it. This built a sense of trust between us. It also shows value in pursuing this aspect of the method further in future work.

5.5.2 Layers of Personal Meaning

The participants appreciated the time I spent in making the sketches and connecting with them on a personal level. On the first sketch, they added layers of meaning with their sketched response. This layering of data visually supported reflection on the important elements of the participants' lives. Through the process of sketching, I added my own interpretation of what they shared with me, and by

doing so, I could better understand their concerns, values and what mattered to them. In turn, they could better understand my thinking in response to their own narratives.

Each sketch had different themes and different sections, which could be viewed individually or as a part of the whole sketch. I saw this as being a useful feature of the sketch. Although the information in the sketches was personal, I found it important that there were few identifiable references to participants' lives. I clearly saw a value in having a female silhouette in the sketches (all the participants were women). The abstract figure helped them to identify themselves in the sketch and connect with it. The ambiguity of the sketch let them connect the lines of the drawing in a unique way by adding their own interpretation of what is important to them and how they see themselves in the current moment.

5.5.3 Capturing the Feeling of "now"

One finding from the research is related to the temporary nature of transitions (see more in Section 5.3.3). The feeling of being in-between does not last. Through a sketch, a participant's current period of transition was crystallised in an image. The sketches captured the transitions that the participants were going through and their reflections of the "now". This process allowed me to find ways to respond to what was happening to them at that moment and for them to share their sketched reflections on where they were in life. When they were responding to the sketches, they focused on the current moment. I saw that it is important to capture a participant's reflections in the moment and share it with them soon after. I experienced (in Jude's case) that leaving a significant amount of time between the creation of the sketch and her response created challenges because it changed the dynamics of our engagement with the sketch.

6 Discussion

This chapter is divided into two parts.

Part *One* discusses the implications of digital design for jewellery as arose from my pieces (both from my point of view and from discussions with a number of experts in the fields of design, jewellery and HCI).

In Section 6.1.1, I offer a reflective view on how digital jewellery can challenge our expectations of digital connectivity, sensor functionality and location awareness.

In Section 6.1.2, I discuss the interactive qualities of the pieces by building on the poetic qualities of interaction with digital jewellery that I have presented in my contextual review (see more p.37)

In Section 6.1.3, I discuss that digital jewellery is often single-function objects but which are tailored and personal to the wearer. In section 0, I open the discussion on how makers can interpret digital data from a craft perspective.

In Section 6.1.6, I discuss how digital jewellery expand existing jewellery practices and in Section 6.1.5 I suggest that making digital jewellery is a multidisciplinary practice.

In Section 6.1.7, I conclude this part on the discussion with a framework for jewellers, which can help them understand and conceptualise digital jewellery. This framework is a contribution to the field of jewellery.

Part *Two* discusses how the methods of *Staged Atmosphere* and *Dialogical Sketching* and contribute to creative methods of engaging people in design research that are dialogical and sensitive to the context under study. This chapter concludes with my reflections on the study and summarises how the research presented in this thesis contributes to jewellery and design research community.

Part *One*

6.1 Discussion on Digital Jewellery

The advances in digital and wearable technology have profoundly changed the way we communicate with each other. Even though research in the field has a longer history, it is only recently that wearable objects and digital objects have entered the social realm by offering platforms to understand our bodily states and communicate with each other in new ways. In a climate where wearable and digital technology is increasingly prominent in our everyday lives, the power we have as makers and researchers to change and expand our potential for engagement with technology grows accordingly. The technological force is moving fast and our expectations have been formed around that notion that the newest technology is better. However, there exists a rich conceptual space that jewellers can tap into when we are thinking of the potential of digital jewellery within our lives. *Topoi, Togetherness, Travelling with Sea and Microcosmos* are examples of digital jewellery pieces made with this research that capture my current thinking and direction of what digital jewellery can be. They offer alternative ways of connecting a person with one's anchor points, significant others and places in the context of travelling between two places of home. These pieces focus on atypical personal interaction with digital objects and present an additional set of questions that reveal different levels of meaning for a person wearing digital devices, while acknowledging the complexity and uniqueness of being human.

As Wright & McCarthy (2003) highlights we do not just use technology, we live with it, and the way we experience it can lead to surprise, enchantment and poetry. In the next section, I will discuss how the resulting digital jewellery pieces expand our understanding of digital connectivity as something that is immediate, predicable and infinite (Wallace 2013). I will discuss digital jewellery in relation to digital connectivity, sensor and location awareness. In so doing, I aim to strengthen the field of digital jewellery as a practice of contemporary art jewellery practice.

6.1.1 Digital Connectivity in Digital Jewellery

Topoi introduces an interaction with layers of microfilm images from places that are significant to the individual which they 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, thereby offering a controlled space where one can explore aspects of herself or himself in private. Only the wearer has 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, as 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.

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. The *Anthos* Brooches invite people to actively wear the piece and tether their experiences to the things that are meaningful to them. They might choose to wear the pieces on a particular occasion; the data then will be interpreted in a significant way and be represented. Two people might choose to wear the brooches on each other's birthday and not the rest of the year - 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.

Microcosmos introduces a similar interaction with the piece. With *Topoi*, however, the digital in this piece enables a personal space where one can enter when the environmental conditions are right. The wearer has no control over the interaction which introduces a very different dynamic to other digital objects we encounter. The wearer knows that the personal data hidden in the piece is there and nowhere else. This very controlled interaction has elements of ambiguity in the interaction, 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.

Travelling with the Sea offers an alternative way of connecting with digital media/data from a place during a flight. The connectivity is situated and specific to the environment of the plane. The digital unlocks opportunities for people to explore geolocation data, via inviting them to experience personal connections during the flight. The piece acts as access portal. We can consider the piece as being a key that allows access to certain type of data. When we design digital jewellery that deals with data, and specifically limited access to data, we should consider who is controlling the interaction. In this case, location defines the type of data presented and thus location can be considered a form of control for digital jewellery.

Opportunities to connect with the world through digital technology during a flight are currently available from a small number of airlines. Current services allow passengers to access their emails, internet browsers and social media. This landscape is rapidly changing. For example, British Airways announced that by 2019 they expect to have 90% of their aircraft connected. Over 10,000 feet from the ground passengers will soon be able to access the connectivity service ".air" and connect with the world instantly (Airways). Other airlines are tapping into the IoT (internet of things), a network of connected devices that aim to improve passengers' experience during the flight and enrich their in-flight experience (Graham, 2015).

This information indicates that current opportunities for digital connectivity on board are limited to current conceptions of the potential of digital technology to connect us with the world through search engines and social media platforms. There is a great potential to think of connections that go beyond the "ordinary" and the "mainstream" to more personal interactions during a flight. *Travelling with the Sea* and *Microcosmos* are a response to this call. These pieces functions only during a flight by offering a connectivity that is specific to the location following the person's changes in spatial dimension. More specifically, *Microcosmos* allows one to enter a personal space during the flight and *Travelling with the Sea* allows the passenger to connect with personal data from one's archive or live data based on one's personal interests. Both pieces connect a person with the current location and thus, with the current moment during the transition, thereby adding value to the actual environment of the plane.

6.1.2 Poetic Qualities of Interaction with Digital Jewellery

In this section, I offer a reflective view on the qualities of the interaction with my digital jewellery pieces based on the qualities that I have identified from the contextual review (p.37). I built upon it by adding the knowledge I have gained from my making of digital jewellery for this specific context. I add one more quality that addresses the duration of the interaction (how my thinking sits within broader discussions on the qualities of digital jewellery will be discussed in Section 6.1.8**.**). In following, I discuss the qualities o f each of my designs:

*Topoi***: time-specific, sensorial interaction.**

Topoi is activated when one decides, thereby 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 is in metaphorical terms, suggesting a sensorial interaction. The personal data only can view only in short bursts is hidden in the piece and nowhere else. This time-specific interaction brings the attention to the person and the connection between the piece, the body and its meaning for the wearer.

*Microcosmos***: time-specific, site-specific, anticipation**

Microcosmos functions only during a flight, thus offering a site-specific and time-limited interaction. From my reflections on the interaction with the piece during two flights, I found the 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, thereby 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; however this lack of precision made the interaction more exciting and my anticipation was heightened.

Togetherness Anthos and Chronos **Brooches: imaginative, unique**

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, thus leaving room for each other's imagination be explored. 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, thereby allowing room for further interpretations.

Travelling with the Sea: site-specific, intriguing

Travelling with the Sea is a digital jewellery piece for the plane. The piece functions only during a flight, thus allowing a passenger to connect with personal data from one's archive or live data based on keywords from the place that the plane is flying over. The interaction is specific to the environment of plane, and the place where the plane is flying over, thereby inviting one to have an intriguing interaction with digital data through personal links.

6.1.3 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, Travelling with the Sea*), 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 light. Similarly, Microcosmos responds to data retrieved from a barometric sensor. In Togetherness, each Anthos brooch acts as a simple 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 and non-intrusive way.

One could argue that the digital functionality of my pieces is very limited in comparison to the vast amount of functions usually found in mass-produced wearables. One respondent (from the Delphi Method) criticised that the resulting digital jewellery do not reach the full potential of data manipulation (and digital technology more broadly) because they do not offer dynamic manipulations of data. In my contextual review, I have talked about how others have criticised the functionality of the piece *Two Rings* by Stoeber (1994). Its function might be seen as being simplistic, however the piece has poetry in its function as the gesture of holding hands is amplified by the illumination of the pieces. Responding to these comments, I 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. More complex manipulations of data and interactions may be integrated within practice over time, but this is not to fixate that this an ultimate goal of making digital jewellery.

The digital jewellery pieces presented in the thesis offer simple interactions if we look at the technology alone (for example in the piece *Microcosmos* an LED light illuminates under certain conditions), however this does not mean that the interaction with the piece cannot be highly significant for a person. In this research, I have explored the field of digital jewellery through making new examples and I presented that even simple interactions may suggest interactions that can be highly valuable for a person in certain occasions.

I 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 digital 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 enchanting ways. This is a methodological decision I took to make digital jewellery, as a counterpoint to existing examples of wearable technology with "the increasing level of interaction complexity" (p.423).

To summarise, wearables are designed on a large scale as mass produced products and they are driven by functional values; whereas, digital jewellery is designed on a personal scale and it is driven by personal values. 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. Within my research, I explored the value of craft as part of my methodology of making digital jewellery and I described that craft as a practice of thinking-through-making (see p.68) and an approach to make something with care for someone (see p.71) is valuable in the design of digital jewellery, bringing the focus on the more personal interaction with digital technology.

6.1.4 Manipulations of the Digital 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 actively wear the pieces and tether their experiences to 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 meaning.

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 gems 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,

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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, symbolise connectivity between the wearers. Time is embedded within the Chronos brooches. As I have presented earlier in the thesis (see Section 4.9.2), 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.

Togetherness allows a wearer to participate in the creation of another piece. I have presented earlier in the thesis that, when designing digital jewellery for personal meaningful experiences, digital jewellery is often co-created with others (see p.185). Togetherness suggests a new form of co-creation where the relationship between a jewellery piece, a maker and a wearer is close.

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. I see a great potential within craft practice to design pieces that are made because of two other pieces being worn.

6.1.5 A Multidisciplinary Approach

Making digital jewellery work is challenging for jewellers as technology becomes increasingly complex. In the quest to acquire a better understanding of the underlying and sometimes very contradictory meanings of digital jewellery, one of the first questions to ask is: what does the digital enables me to do? (conceptual level) and how I can make it happen? (practical level). Admittedly, there is big difference between working with textiles, paper, metal and other more traditional material compared to working with digital. The main difference is that digital is intangible and its manipulations are not only physical (see more Section 5.2 p.

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191). Technologists have a good understanding of digital technology as well as the knowledge of components that are valuable for digital jewellery. However, I saw through my practice that a hands-on understanding was an important step in understanding the material and its applications. Therefore, the answers to the questions above come from both the jeweller's engagement with this material and its practical understanding (how to do something, how something works) and from conversations and collaboration with technologists.

For digital jewellery, it is not about designing the technology, but it is about designing the function. Often people who are designing wearables design the technology, however we need to design the function not the technology. To give an example, for the Travelling with the Sea piece, it is not about the NFC communication, it is about sharing information in proximity; it is not about cloud services, it is about connectivity that is very specific to one's current location. When we as makers start thinking about what the technology enables then we can work closely with technologists to find out what is the best way to achieve a desirable function.

Without some basic knowledge of the "know how" and understanding of the digital on a technical level, I can argue that it is hard to imagine the possibilities of this material at a conceptual level. If makers have acquired the basic knowledge of working with the digital (switches, power source, physical-digital communication, digital design in some cases), then collaborations with experts could benefit jewellers not only at a technical level, but also at a conceptual level. The implications of this will be that jewellers can include digital technology in their thinking when designing new pieces of digital jewellery. Making digital jewellery needs to be inherently collaborative, thus, a multidisciplinary approach to digital jewellery is indispensable.

6.1.6 Digital Jewellery Expands the Field of Contemporary Jewellery

Digital technology is understood to be an additional material in the jeweller's palette that offers the possibility to explore new ways of connectedness with the self, significant others and places. From this perspective, the variation of materials (traditional and digital) and new ways of making are tools for jewellers to create pieces that stimulate and provoke emotional responses. As contemporary jewellery

makes people position themselves in a personal, societal and cultural context (Besten, 2011, Unger, 2011), this has proved to be incredible enriching for jewellery practice. Such pieces are not often intended for a specific wearer; they are often implying the body and the wearer in metaphorical terms. Significantly, this jewellery leaves space for the viewer/wearer to reflect on who they are, what they stand for or what they want to be (Broadhead, 2005, Veiteberg, 2013). The digital is, therefore, an interesting development in the relationship between makers and wearers and jewellery pieces.

Digital jewellery also opens the field of Contemporary Jewellery outside its profession and can contribute to existing limitations of the practice to constrain intricate social relationships (Cohn, 2009). It offers new opportunities to connect with significant others and places in ways in which traditional jewellery cannot do. Digital technology offers new opportunities for jewellers to expand the social potential of jewellery to connect with one's self, other people and places in personal meaningful ways. Digital jewellery, as part of contemporary jewellery practice, is free from constraints driven by current trends and certain aesthetic constraints. All respondents (see p. 182) agreed that digital jewellery is jewellery first and makers are free to choose the materials and functionality they want based on their conceptual framing.

Travelling with the Sea questions the more accepted view of digital jewellery, that of being owned by someone. Similar to other examples of contemporary jewellery, the piece is not owned by a person, yet it offers an experience. In my contextual review, I referred to Susan Heron's and Monica Brugger's work as being examples of jewellery that offered the perspective that a piece of jewellery can be an experience of a moment. In *Light Projections* (1984), Heron explores the sensation of wearing light on her body. In a series of pictures, she captures herself "wearing" the projected lines. Jewellery can be a sensation; the body moves and the piece changes, leaving an impression of the moment. Similarly, *Game me* (2000) was an installation set up by Monika Brugger, where visitors were invited to explore their body and experience a physical sensation similar to wearing a necklace of light. In a similar vein, *Travelling with the Sea* can leave an impression; as the planes changes location, the data that is shown changes, connecting a person with a place temporarily and fleeting moment.

6.1.7 Making Digital Jewellery: Towards a Framework

Digital jewellery focuses on the idiosyncratic traits of a person and what is meaningful for her/him personally. Digital jewellery differs from wearable devices in a number of important ways. From the discussion with the experts, I summarise that digital jewellery is different in its purpose, its views of the body and its relationship with the wearer or the owner (see more in Section 5.1.5). In this section I have summarised the qualities that are important for makers to consider when designing digital jewellery.

1. The personal connection between the wearer and the digital jewellery

2. The synthesis between form and functions

3. The conditionality that connects interaction with functions

4. The coupling that unifies interaction with the form

5. The limitations of the digital components

These values are illustrated as the layers of a framework for digital jewellery. At the centre of this framework, *Meaning* is located. *Meaning* defines the personal connection between the wearer and the piece of digital jewellery. *Meaning* is one of the elements that differentiates digital jewellery from wearable technology. Digital jewellery always supports meaningful connections between the wearer and the object and it can ground and support one's sense of self (see more in Section 5.1.3).

Form represents an easily identifiable and mostly visible part of the piece, its materiality and its *form*. The importance of *form* in digital jewellery highlights the need for a maker's sensitivity in working with digital as a material and it raises the question of the narrative in the *form* of the digital jewellery piece (see more in Section 5.1.2).

The *function* of the piece represents the personal and intimate engagement with the digital jewellery. The *function* of the piece is partly conceived by the maker through the design of the object and its physical and digital capabilities, and partly conceived by the wearer who ascribes *functions* to the piece.

The *interaction* refers primarily to the way in which the wearer interacts with the object in different ways and the poetic qualities that emerge from these

interactions. *Interaction* with the piece is an element of jewellery design that becomes even more important in jewellery design because the designer typically imbues the digital jewellery with interactive functions.

Form, function and *interaction* are connected by different attributes which I will describe in detail when I discuss each of these layers.
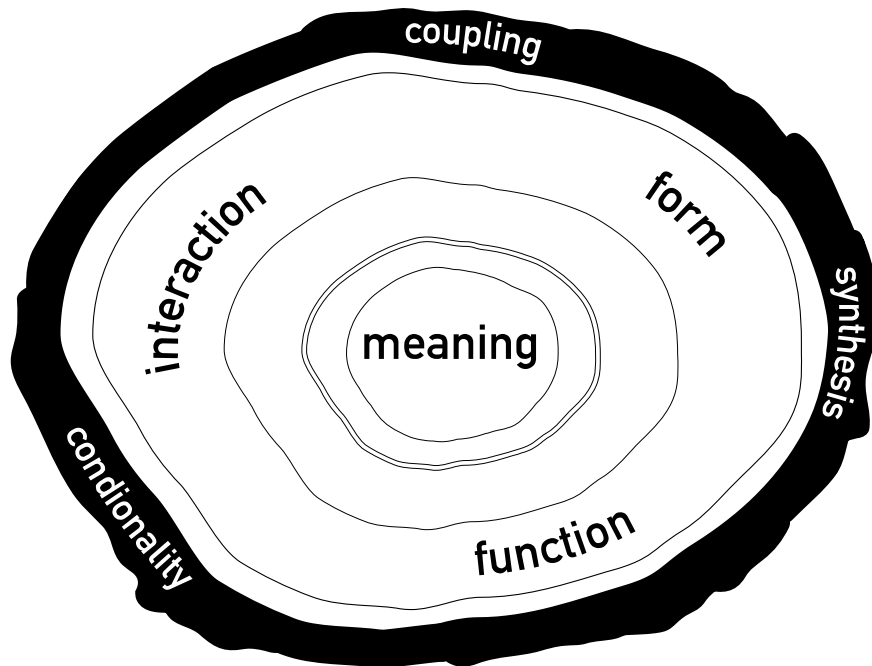
Figure 6.1-1 A framework for understanding and conceptualising digital jewellery

6.1.7.1 Meaning: The Personal Connection with the Wearer

Digital jewellery starts with the person and the person's values such as what makes her/him laugh, feel comfortable, and connects her/him with significant others and places in a very personal and idiosyncratic way. Thus, digital jewellery are objects concerned with one's sense of self and emotional significance and is situated principally in the field of contemporary art jewellery (Besten, 2011, Dormer and Turner, 1994). It is what makes digital jewellery able to take advantage of advances in wearable and digital technology and still stay faithful to the values behind the social and cultural role of jewellery in peoples' lives.

Digital jewellery expands the social potential of jewellery to connect us with ourselves, significant others and places. Digital jewellery offers this potential to

connect with significant others and places in a way in which traditional jewellery cannot. Its fundamental function is to offer the space for personal significance and provide a link to one's anchor points. With anchor points, I refer to a person's meaningful connections that can ground and support one's sense of self. In this space, digital technology is a material that offers the possibility to explore new ways of connectedness with the self, significant others and places.

A number of people can read the functionality of a wearable device and anyone can use them for that function (for example, a fitness tracker), whereas the functionality of a digital jewellery can best be interpreted by the wearer/owner. The data that is stored in the piece (or can be accessed in certain conditions) are emotionally charged by the wearer and the interaction with the piece is personally meaningful to the wearer herself/himself. Therefore, a piece of digital jewellery becomes meaningful for a person because it offers an experience that the wearer values in a personal way.

In designing digital jewellery for personal meaningful experiences, digital jewellery is often co-created with others. The relationship between a jewellery piece, a maker and a person should be close. As digital jewellery is often designed for a specific person, its quality can best be evaluated by him/her in its success to offer personal meaningful interactions. Two respondents' views (R1, R4) agree that digital jewellery, similar to non- digital jewellery, attributes personal meaning to the pieces, collecting insights about the wearers/owners' life through a shared history. These views indicate that it is this personal connection that should make a piece of digital jewellery meaningful to its wearer.

Most of the experts (R1, R2, R3, R4, R5) agree that when a maker is designing digital jewellery it should be designed to have features that serve a specific person. R1 commented that a digital jewellery piece may also have features that the wearer created herself/himself. This idea that the features should be tailored to the wearer is one significant challenge that the designers of digital jewellery must overcome.

6.1.7.2 Meaning: The Relationship with the Body

Within digital jewellery practice, the relationship between the piece and the body is important. Similar to non- digital jewellery, digital jewellery gains intimacy as objects relate to our personal narratives and as objects are placed within the

personal space of the wearer. Digital jewellery does not view the body solely as something that can be measured and controlled. The emphasis is placed on the lived experience (Wright at el. 2008, Wright and McCarthy, 2010), where the body is explored from a range of perspectives. In *Topoi*, for example, the wearer is a type of key that allows access to the piece; its power source in metaphorical terms.

Rather than figures and graphs resulting, for example, from a Fitbit, the body should be explored from an experiential perspective, as well as through its physical dimensions, such as body temperature and heart rate. There exists a range of wearables that look at ways that biometric data can be mapped and visualised in different ways (see more Section 2.3 p.17). I see this type of mapping biometric data into light, movement or graphs as being a simplistic way of understanding human emotions. When we are aiming to design for emotions, I propose that it is important to think of emotions as one facet of experience. Gaver *(2009)* describes this well:

> *Clearly, emotion is a crucial facet of experience. But saying that it is a 'facet of experience' suggests both that it is only one part of a more complex whole (the experience) and that it pertains to something beyond itself (an experience of something). It is that something – a chair, the home, the challenges of growing older – which is an appropriate object for design, and emotion is only one of many concerns that must be considered in addressing it. From this point of view, designing for emotion is like designing for blue: it makes a modifier a noun. Imagine being told to design something blue. Blue what? Whale? Sky? (p.3598)*

When designing digital jewellery for rich and meaningful experiences, makers need to understand what is important for the people they are designing for (not just monitoring and tracking the wearer's body). The makers should acknowledge the tight relationship between what people do and how they feel about what they do. In order to do this, makers should help a wearer give value to, and give meaning to what they do and what happened to them (Wright at el. 2008, Wright and McCarthy, 2010). Emotions, feelings, fears, dreams or desires cannot be measured in numbers; rather, they must be shared through a dialogue between the designer and the wearer. As a respondent from the experts' conversation suggests, the wearer's body should be seen as "a site of self" rather than a mechanism from where data could be extracted. Digital jewellery explores the interaction with the body in a very sensorial and experiential way.

6.1.7.3 Conditionality: Poetic Qualities of the Digital

Drawing from existing examples of digital jewellery (see Section 0 p.37) and the conceptual framing of designing for enchantment (see Section 3.6.1.1 p.77), I designed examples of digital jewellery practice from a range of perspectives, including the qualities of interaction, to reveal the meaning associated with digital jewellery as objects that can be highly personal and significant for someone. I argue that digital jewellery creates personal triggers by enabling interactions with a piece based on *poetic qualities*. These qualities refer primarily to the function of the piece and the wearer's interaction with the object. These qualities are:

- Unique: a quality that suggests that a part of the process occurs only once; the process is not reversible or repeatable.

- Anticipation: a quality that questions the pace of an interaction with the digital. The wearer anticipates the interaction and thus can reflect on the significance of the piece.

- Site-specific: a quality that addresses the location in which the interaction occurs. By having a unique location to connect with the piece and its content, a wearer can connect with a place and/ or the piece in an intimate way.

- Intriguing: a quality that arouses the curiosity of the wearer to explore the interaction with the piece in short turns.

- Sensorial: a quality that relates to the senses or the power of the digital sensation.

- Imaginative: a quality that leaves the space for open interpretation or creative response to the digital.

- Provocative: a quality that raises social, cultural or political issues in our digital culture, such as identity.

- Time-specific: a quality that addresses to the duration of the interaction.

I suggest that these qualities are important because they can open up new possibilities for designing for personal and intimate engagement by acting as propositions for research on how digital experiences can present more intriguing interactions and not definite answers. The list in not complete, however, I highlight

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these eight poetic qualities are important as they offer a certain frame of mind that I believe can be beneficially to other makers when they are making digital jewellery. These qualities propose what I call "conditionality" in the interaction. Depending on a condition or conditions of the piece, the environment or the wearer her/himself, a certain function is allowed to happen. In *Microcosmos*, for example, the wearer has no control over when the piece will function. However, *Topoi* only functions for a limited time when one decides. *Conditionality* is an attribute of digital jewellery that, I suggest, we need to consider when we are designing digital jewellery for personal and intimate engagement in different contexts and we should ask ourselves the following questions: *When and where does an interaction occur? Under what conditions? Why is this interaction important for the wearer?*

6.1.7.4 Synthesis: Narratives of Form and Function

It is widely acknowledged that jewellery pieces tell stories (Ahde-Deal, 2013, 2017, Potter, 2007, Rana, 2014). Among the social, cultural and political stories, jewellery pieces often carry a personal story and a connection with the wearer. The narratives that accompany the piece adds value to it. They are often embedded in the form and can trigger memories that are significant for the wearer and/or the maker. The narratives relating to the materials in digital jewellery are also an important issue for makers. Often wearable technology relies on technological solutions that focus on functionality and efficiency via offering a limited interpretation of what digital jewellery could (Versteeg and Kint, 2017, Wallace et al., 2007). I add to this that, this limitation extends to the narrative associated with the pieces.

The visual qualities of a piece are an important element of digital jewellery. The materials and forms of the pieces play a key role in distinguishing pieces of digital jewellery from wearable devices. R2, R4 and R5 saw value in the material qualities of my digital jewellery and were intrigued by the range of material (from twig to resin to metal). R4 also commented on the semiotic aspects of the pieces *Microcosmos* and *Topoi* (for example the spoon-parts gave a clue on how to interact with the pieces). The subtle switch mechanism of the *Anthos Brooches* and *Topoi* was an attribute that three of the respondents (R1, R4, R5) highlighted as being a positive step towards a more integrated meaningful aesthetic of digital jewellery. R3 noted that it is important for jewellers to think about the visual

qualities of their digital jewellery pieces and find out a visual language that is more jewellery-like than gadget-like.

In digital jewellery there is an inseparable connection between the function of the piece and its form and materials. The synthesis of form, material (including the traditional and digital) and interaction is another difference between pieces of digital jewellery and other wearable technology. R4 and R5 found two of the pieces *(Microcosmos and Topoi)* intriguing as pieces of digital jewellery as they commented that their technological functionality was fully integrated into their conceptual narrative. R5 reflected that their interactions with the pieces were sensitive and intriguing, and it was easy to see how they could elicit an emotional reaction from their wearer just by reacting to their touch. However, *Travelling with Sea* received criticism that it lacked a meaningful integration between the physical and the digital within the object. Experts critiqued the function of *Travelling with Sea* to unlock data on another device (in this case a smart phone). Using an application in conjunction with a digital jewellery piece was something that they criticised as a functionality that does not fit with the narrative of jewellery. In this instance, they struggled to see the piece as being digital jewellery.

For some respondents, digital jewellery appears to have certain functionalities that are more jewellery-like (holding and storing personal data). The personal data can be accessed in certain conditions. Typically, traditional jewellery interactions (such as clipping on a brooch or wearing a necklace) were considered to be the appropriate type of interaction for a digital jewellery piece. I believe that this is a narrow perspective on what digital technology can do within jewellery practice. In following existing interactions and expected functions of jewellery, makers can find inspiration and links with the field, however they should not limit themselves to existing boundaries.

6.1.7.5 Coupling: Interaction between Physical and Digital

The *coupling* between the analogue and digital element of digital jewellery is important. Analogue and physical are coupled together in ways that enhances the interaction with the piece. In a well-designed piece, R4 suggested that the physical and digital behaviour are aligned, for example, if *"a digital locket opens smoothly, you expect the light to fade in. If the locket opens in a more staccato way, you expect the content to light up in discrete steps"*. R4 commented on how in

Microcosmos the fading in and out of the LED builds tension and has a subtlety that is very jewellery-like. He found it intriguing how the digital and the physical merge in the output and how the intensity of the light intensity determined the readability of a physical text inside the piece.

When we are designing digital jewellery, we should be aware that familiar interaction with digital objects (such as tap, swipe, and scroll) might change how the piece is perceived. Using an application in conjunction with a piece of digital jewellery can also be problematic for some as the interaction is related to our interactions with wearables. Traditional interactions that we would normally see in traditional jewellery can inform digital jewellery. The *Anthos Brooches* offer an interaction (fastening the pin) that is very jewellery-like, and three respondents (R1, R3, R5) found this to be desirable. With this interaction, the digital became very tangible and that was something that one of two respondents highlighted as being valuable within digital jewellery practice (R1). On the contrary, swiping the *Travelling with the Sea* piece over a smart phone was an interaction that a respondent found very gadget-like and not natural for jewellery (R4). On reflection, it appears that neither electronic nor jewellery-based interactions are appropriate interactions for digital jewellery. Rather, by coupling the interaction with the form creates digital jewellery with interactions that are neither electronic nor traditionally inspired by jewellery. Instead, digital jewellery that is coupled defines interactions that are unique to the field.

6.1.7.6 The Limitations of the Digital Components

The meaning of the electronics is on the interaction and not on the material per se, however, makers have to take the physicality of electronics into consideration and work with the challenges that they bring in terms of selection of the components, the size of the prototype and the power source. Printed boards, soft sensors or flexible structure are available; however, they are often useful in later stages of prototyping when the concept and interaction are more defined. Typically, the prototyping process starts with square and fixed hard surfaces.

In the first phases of the prototyping process, makers might need to comprise with the scale of the prototype and bear in mind that downsizing a prototype can be both very challenging and time-consuming. It is important to consider the power

source from the beginning of the making process.

Another practical element that makers need to consider when they are designing digital jewellery is the lifespan of the electronic components. As the relationship between a piece of digital jewellery and its wearer could be long-lasting, one of the respondents in the Delphi method raised the issue that how the technology ages should be an area of our concern. These comments prompt the questions:

How long can we use a piece of digital jewellery in reality rather than theory? Can the technology embedded in the piece be supported in 10, 20, 30 years' time?

6.1.8 Contextualise the framework

My research on digital jewellery responds to the growing calls in the design and HCI community to develop alternative approaches that enable people to interact with digital technology and personal data in more reflective and curious ways (Wallace et al. 2017, Odom et al 2019). It does so by opening opportunities to enable people experience connectedness to their own self, significant others and places of home in poetic ways. My way of thinking on what digital jewellery is captured on my designs and my reflections. These reflections are summarised in my framework which I presented in the previous section. The framework has been the result of my theoretical and practical investigations on digital jewellery during this doctoral research. In this section I present the significance of the framework and its relation to others' work in the field.

To date there is not a comprehensive framework for understanding and designing digital wearable objects with the lens of contemporary jewellery art practice. A recent attempt is Moller and Kettley's (2017) discussion on the relevance of Cunningham (2008)'s framework in the field wearable health care devices. This is a significant move towards alternative approaches to designing technological devices in relation to the body. Cunningham (2008), a jeweller and writer, provides a valuable insight into ways of thinking about the relationship between the maker, the wearer and the viewer of a piece of jewellery. A piece of jewellery, he argues has layers of associations and narratives attached to it, which brings the maker, the wearer and the viewer in a complex relationship of meaning making (Cunningham, 2008). By wearing a piece, Cunningham suggests that the wearer becomes the interpreter of the work of a jeweller. The context changes and the wearer may respond to the piece in very

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different ways depending on their personality, the way of dressing and moving for example. Thus, the wearer's interpretation of a piece of jewellery is open-ended and personal. The viewer on the other side has the opportunity to interpret the meaning of the objects through the context in which the piece is brought together by the maker. What differentiates Cunningham's (2008) framework and my own framework is that I specifically highlight the need to explicitly consider the digital elements to the work.

This triangle of maker-wearer-viewer is useful framework in the design of wearable health devices (Moller and Kettley 2017). This is a contribution to the field of digital jewellery more broadly, as it highlights the value of a design approach that includes a wearer's physical, psychological and social preferences when we are designing digital devices for the body. Considering the wearer holistically is the commonality between this model and my own framework. I argue that in order to design for these potentially rich and meaningful experiences for people, we need to understand the very personal and idiosyncratic traits of individuals. However, the framework I developed within this research goes on step further to present strategies that makers could apply in the designing of digital jewellery pieces that people find personally meaningful. Saying this, I emphasise that the wearer's interpretation of a piece of digital jewellery, similar to jewellery, is open-ended and personal (Cunningham, 2008)

Alongside this framework, within the HCI and interaction design research there has been a rise in design methodologies that seek to address the whole body and the felt experience of the person (Wilde and Andersen, 2009, Wright and McCarthy, 2010, Höök, 2013). These approaches go beyond the cognitive models of a person, towards the holistic and humanistic (Kettley et al., 2017). My framework sits also along these approaches. It differentiates from these approaches, however, because of my framework's explicit focus on the jewellery-specific qualities of the designed objects.

As a result of my research, I argue that digital jewellery can create emotional triggers for the wearer suggesting atypical interactions with digital technology

By framing these qualities as poetic qualities of interaction, I invite others to think through them and question how a piece of digital jewellery could lead to a surprising, intriguing, imaginative use of digital technology. This way of thinking has also similarities with others who have explored the aesthetics of interaction (e.g. Ross, 2010, Forlizzi and Ford, 2000; Davis,

2003; Overbeeke and Wensveen, 2003). Some of these qualities and alternative framings of the digital has been presented by Olivier and Wallace (2009) in Human-Computer Interaction literature. Building upon their premise of open and varied design interpretations of the digital, I strengthen the argument that digital jewellery often offers site-specific, unique, surprising, sensorial, provocative interactions or provoke anticipation and digital sensation.

Part *Two*

This research sought to find ways to empower an unsettled sense of self in the context of short-term transitions. In this research, I presented the potential of the method of Staged Atmosphere and Dialogical Sketching. Both methods were developed for the purpose of this study. In my creative engagements, designers and participants are in dialogue to conceptualise and understand the richness of a transitional experience in order to inform design practice.

Staged Atmosphere is a method of engaging people to talk about their feelings, their frustrations, their excitements or moments of anticipation to explore design opportunities of reassuring the self in the context.

Dialogical Sketching reveals the full potential of using sketching within design research to form an ongoing conversation with participants in exploring feelings about transitions in very gentle and imaginative ways.

In the next sections, I situate *Staged Atmosphere* and *Dialogical Sketching* within the probe approach and discuss how these methods widen the probe approach, contributing to creative ways for engaging participants in conversations around their sense of self. I will also discuss the limitations of each method and how they can be applied in future work.

6.2 Widening the Probe Approach

6.2.1 Staged Atmosphere

Probes and the variations of this method are seen as being valuable tools in design research through gaining rich insights into lived-experiences (see Chapter 3 Section 3.3.260). Although they have been adopted widely, significantly less attention has been given to the environments in which probes are being introduced. I see probes as being valuable tool to gain a rich understanding of people's transitional lived experiences, when designed within the probe approach (Boehner et al., 2012, Gaver et al., 2004a). However, I argue that the environment where probes are introduced and worked and how they are shared with the participants are also of great significance and deserves attention.

The method of Staged Atmosphere proposes a multi-sensorial experience where participants and designers can get a rich understanding of how a certain situation affects their sense of self in context. This research presented the experiential qualities of using probes within liminal spaces (in this case of planes and airports). The word "atmosphere" is used to employ elements of authenticity; being in the real place and exploring the atmosphere of the real environment. The word "staged" as the method has elements of theatricality, indicating that the experience is close to the real one, yet still fictitious enough to leave room for participants' reflections and imaginative thinking. I saw that there is a potential within design practice to consider liminal spaces as being contexts where people can share aspects of their sense of self and which can be insightful and inspirational for design.

Expanding from experience prototyping practices (Buchenau and Suri, 2000), I argue for the value of a perspective in which the design of the probes, the space where they are introduced and the theatricality of their deployment are important to elicit rich reflections about a context and stir participants' imaginative thinking. Even though people have an intimate capacity for remembering and imaging places, this experience is not as stimulating as the actual experience of being in a place, as the latter is a multi-sensorial and emotive experience in the constant interaction between a person and one's surroundings (Zumthor, 2006, Pallasmaa,

2012). When engaging people to reflect on feelings and emotions in transition, I suggest that it is not enough to create an abstraction of a particular environment (Buchenau and Suri, 2000) because an important part of the experience of this space is lost. In this respect, when design researchers aim to gain a rich understanding of how a transitional experience affect the sense of self in context, they should consider the liminal spaces as the design activity is being introduced, as they can stimulate feelings and emotions of the actual experience that would not be possible otherwise.

The bespoke nature of probes contributes to the discussion on the personal gains of participants in participatory design processes (Iversen et al., 2010, Vines et al., 2013) as they bring back the subjective mark and expression of designers in the process of designing the probes and enrich the conversation between the designer and the researcher.

Comparing the Air[craft] workshop with the meeting on an actual train journey with one of the participants (see p.137), I realised that the constraints of the actual journey (other passengers, phone distractions, ticket control) disturbed the flow of the workshop and constrained Jude's reflections. A certain level of control over the activities proved to be vital in order to keep the flow of the workshop going and create the space for reflection. This understanding endorses the argument that the notion of the Staged Atmosphere can be a valuable method to create opportunities for people to share aspects of their self with the researcher, as it values the authentic environment where the transition takes place, yet creates the environment where the participants can be immersed in the experience and reflect on personal aspects of themselves.

6.2.1.1 Limitations and Future Work

There are some interesting issues that arose from participants' engagement in the study. As design researchers, the participants were well placed to explore the role of digital jewellery in the context as they understood their experience of being in-between. These qualities resulted in an interesting form of participation that added depth to the exploration, however this was not without its challenges. Because I was setting up a *Staged Atmosphere*, people can be seen to be actors with multiple roles (themselves, passengers, researchers), acting in the way that they think it is appropriate. Although I cannot ignore the fact that the participants were

not naïve, they were three people with different personalities and different experiences of this particular transition, bringing valuable insights in understanding this particular experience of a short-term micro-transition.

Diane shared with me that she felt that the different roles we are all "playing" were very open in a way that she could still be herself and reflect on the context. In her words:

> *"The roles were very open, they were not very far away from actual people themselves, so we were performing characters, but we were performing ourselves in sort of stylised way. The way you were when you performing as the flight attendant, you were still you, but you were stylised in things so that you could give the certain ideas or feelings." [Diane]*

During the workshop, I was aware that participants wanted to interact longer with certain probes, yet they were limited to a certain timeframe as the workshop progressed. During the reflective session at the airport, participants were given the space to chat about the workshop. Participants discussed the challenges in the interaction with the probes, the reasons why some probes did not feel right for them and they shared with me an additional level of reflection on their feelings in the context.

6.2.2 Dialogical Sketching

Dialogical Sketching is a sensitive, non-descriptive method that opened alternative ways of documenting sense of self and capturing layers of personal meaning over time. The method sits alongside other visual methods in Design and HCI research, such as design probes (Gaver et al., 2004a, Wallace et al., 2013) context mapping (Stappers and Sanders, 2003) or the use of portraiture (Blythe et al., 2010) which have been documented as being valuable tools that can be used to open conversations with people about their lives. It is also a tool to document people's lived experiences (Berger, 1993).

Dialogical Sketching is a process of self-discovery (Goldschmidt, 2003) and within the context of this research Dialogical Sketching is a way of doing autoethnography (Ellis et al., 2011). It is a process of self-discovery because through the sketches the participants experienced a dialogical exploration of their sense of self. Through the sketches they could see themselves through my own interpretation of how they feel and what matters to them, which helped them better understand how they felt in the moment. As McCarthy and Wright (2015a) argued

it is in the "*presence of another person's voice that brings [participants']*
particular perspective and experience into dialogue". It is only through this
perspective of the other that people can understand each other and themselves.

Dialogical sketching was an explorative process that used the medium of sketching
as a means of capturing participants' lived experiences, which can be considered to
be a form of autoethnography. Sketching became a form of autoethnography
through self-discovery because it supported participants in documenting and
visualising this discovery. Through iterative sketches we had a conversation that
was open to interpretation, rather than representing something definite, opening
spaces for mutual appreciation and reflections on self. The process of shrinking
down the initial sketches and centring them in the middle of a sheet of paper
created a rule of engagement and a clear, limited space to sketch inside. In Laura's
account, this process enabled an iterative visual dialogue between us which was not
bound by certainty, but more by inference, interpretation and suggested meanings.
As result of the process, a flow of sketches was created like a back and forth
between us in the form of a conversation.

The method offers a way of looking at probe responses as being ongoing, where
participants and researchers add their interpretation by adding new layers of
personal meaning. This is particularly helpful when people are going through a
difficult situation in their lives. Keeping track of their changing sense of self is
helpful because they can build a better dialogic (Holquist, 2003) and reflexive
(Giddens, 1991) understanding of what they are going through during the
transition.

Within the research, I discovered the potential of *Dialogical Sketching* as a
method that offers a way of documenting sense of self in a temporary way, whilst it
offers the space for participants to share their thoughts and feelings in non-literal
ways. I see potential in exploring further this notion of "now" and building upon
the system of dialogical sketches in future work to sustain a long-tern ongoing
dialogue between researchers and participants when focusing on aspects of sense of
self. This connects well with the temporal nature of the sketch and its characteristic
as a medium to be developed and explored over time (Gedenryd, 1998,
Goldschmidt, 1994, Pallasmaa, 2009, Schon, 1984). I suggest that the method can
be valuable (both when researchers are designing and deploying probes and also
unconnected to the probe method) in being sensitive to both the participant and the
context and when thinking of participation over time. I argue that the method firstly
enriches the probe approach, secondly it encourages discourse in open and often

uncertain ways and thirdly it enables a long-term ongoing participatory engagement even through challenging circumstances. It also contributes to discussions on the value of sketching in understanding one's lived experience within design and HCI research.

6.2.2.1 Limitations and Future Work

I acknowledge that the method is appropriate for people who are comfortable in expressing themselves visually, because for dialogue to happen between the sketcher and the sketch, a high level of skill practice is necessary (Goldschmidt, 1994). In this research, sketching related to participants' design practice and my own. In capturing the complexity of different transitions, it was interesting to see that the process of shrinking down the initial sketches and centring them in the middle of a sheet of paper created a rule of engagement and a clear, limited space to sketch inside. However, participants sometimes hesitated to contribute to the sketch because they felt that they would "ruin it". Finding a balance, however, between a finished work that people value as an artwork and an unfinished, but beautiful, sketch that they want to engage with is necessary, yet challenging.

Further work could be done in order to find ways to encourage participants to contribute to sketch in ways that is comfortable to them, but this is not to fixate that this is the aim of this method. Here, I offer some suggestions: I saw that the white space and the monochromic monochromatic prints were important characteristics of the sketch to engage participants in a visual dialogue, yet further work can be done to explore how the amount of white space around a sketch (or the unfinished-ness of the sketch) allows people to participate in the sketching process. A suggestion for future work would be to explore different ways to encourage people to make marks in the sketch, for example, to consider the use of tracing paper instead of a standard A1 sheet which could be used to trace pictures from other sources. The unfinished-ness of the sketches by drawing, for example, figures as outlines, or only half of an object, allowed the women to participate in the sketching process. I suggest that illustrating, for example, a variety of emotions in the sketch could be helpful for participants to identify their mood and connect emotionally with what is being illustrated.

6.3 Summary of Key Contributions

In this section I summarise the key contributions in the field of contemporary jewellery with a deeper understanding of the nature of digital jewellery and to the design research community with creative methods for participatory engagement.

Contemporary Jewellery

The resulting digital jewellery capture my thinking and direction of what digital jewellery can be. They offer alternative ways of connecting a person with one's anchor points, significant others and places, thus suggesting intriguing interactions between the wearer and the piece. The resulting pieces are contributions themselves as new objects that are both jewellery and digital devices that can potentially support one's sense of self in transition. The pieces offer different ways of supporting sense of self (i.e. a piece that only functions on the plane) and they add something new to the jewellery community.

Taking these examples as propositional objects, I explored in dialogue with a small group of experts the context and implications of digital jewellery within contemporary jewellery practice revealing a rich conceptual design space. I offered a framework for designing digital jewellery. The framework discusses the poetic qualities of the jewellery pieces by unfolding the narratives associated with their function and form and contributes to discussions around how jewellery practices and digital technologies can suggest experientially rich interactions for people.

Design Research

The designed methods contribute to design research by enriching the role of design practice to offer dialogical and sensitive methodologies. With this research I contribute to the context of the probe approach in design research with the method of *Staged Atmosphere* and the method of *Dialogical Sketching*.

Staged Atmosphere: The method of *Staged Atmosphere* proposes a multi-sensorial experience where participants and designers can get a rich understanding of how a certain situation affects their sense of self in context. *Staged Atmosphere* is a method of engaging people to talk about their feelings, their frustrations, their excitements or moments of anticipation and explore design opportunities of reassuring the self in the context. The design probes, the space where they are introduced and the theatricality of their deployment are equally important in order to elicit rich reflections about a context and stir participants' imaginative thinking.

Dialogical sketching: Probes are often on/off explorations in gathering data of

people's experiences, via offering a single interaction where participants respond to the activity in a creative way. The method of *Dialogical Sketching* offers a way of looking at probe responses as ongoing, where participants and researchers add their interpretation by adding new layers of personal meaning through sketching. The long-term ongoing aspect of the method and the active role of participants in interpreting probe responses are the contributions of this method to the wider context of the probes. This use of sketching in understanding one's lived experience is a contribution within Design and HCI research.

7 Conclusions

The relationship between jewellery practices and wearables research is often debated and, at times, polemic. The rich discourse of digital jewellery is not tided up with consumer and industry practises, it has its avant-garde, art worlds and forms of resistance. A way to think about digital technology, and perhaps think about its marvellous possibilities is to open them up to intervention and experimentation. I believe I have shown that there is still an important contribution to be made in further exploring the role of digital jewellery in 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 proximity to wearable technology and the commercial application of technology.

Although digital jewellery differs from existing examples of wearable 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. I believe that digital jewellery (within the field of wearable technology) is undervalued. Arguing for a fundamental reconfiguration of our understanding of digital jewellery, this thesis 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. My argument, however, is not an attack on wearable devices or other technological developments. I 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. We need to keep in mind that there is not a right way to design digital jewellery.

My initial research focus was to explore contemporary jewellery practices and understand how digital technology can be incorporated into forms of digital jewellery that suggest experiential rich interactions for people during micro-

transitions. In this exploration I was concerned with designing digital jewellery as objects that could potentially suggest highly personal and meaningful interactions for the wearer. My thinking drew on jewellery practices, as opposed to human-computer interaction or interaction design, to bring the focus on a sense of self, personal significance and the body. Inspired by the stories of three female design researchers who experience feelings of transition and my own lived experience of being in-between, I designed the pieces *Topoi, Togetherness, Travelling with the Sea* and *Microcosmos* that suggest alternative ways to support self during micro-transitions. Taking these examples of digital jewellery pieces as propositional objects, I facilitated a creative discourse among a small group of experts in the field of digital jewellery. In this way, the research opens up a valuable debate in the field of Contemporary Jewellery. The conversations facilitated a discourse at a community level which is a contribution to the field. Insights from this conversation informed a framework for conceptualising and designing digital jewellery, which is a practical contribution to the field of digital jewellery and jewellery more broadly.

I ask jewellers to review existing examples of digital jewellery and my own creative practice and I hope to encourage them to rethink the potential of digital objects in peoples' lives. This will allow makers to engage with them further in discussions on how the digital as a material within jewellery practices can enriches our lives in more personal and poetic ways. This would present a significant step by makers and jewellery practitioners towards a better understanding of the potential role of digital jewellery in peoples' lives.

My thesis presents three lessons to be taken forwards in the future:

- Firstly, that digital jewellery enriches the social potential of jewellery, thereby opening up new ways of connecting people with significant other, places and their own sense of self in personal ways.

- Secondly, that digital jewellery challenges our current expectations of digital technology as being immediate, direct and infinite, suggesting interactions that reveal the sensorial and imaginative aspects of digital technology.

- Thirdly, that digital technology enriches contemporary jewellery practices and becomes an additional material in the jeweller's palette. I suggest that if we consider digital technology as a material within jewellery, then digital jewellery can be simply described as jewellery.

Digital jewellery ought to be tailored to a person and offer a particular experience that the wearer values. It is not possible to think of digital jewellery without thinking of the wearer and what he/she values. However, in order to design for these potentially rich and meaningful experiences for people, designers need to understand the very personal and idiosyncratic traits of individuals. Therefore, it is important for researchers in the field of digital jewellery to think of ways that make people comfortable in order that they are able to communicate personal aspects of their lives with the maker. Within this research, I contribute to creative ways for engaging participants in conversations around their sense of self with the method Staged Atmosphere and Dialogical Sketching. These explorations widen the probe approach and offer design researchers inspirational tools that are sensitive to the research context.

Short-term micro-transitions have not been studied by the design community in order to help support development of the sense of self. The design community could afford more time to the study of transitions which, in turn, could offer insights (from a designer's point of view) into how people experience such periods. Within the context of this research, I identified that airplanes act as a space for the design of digital jewellery that can be attuned to the changes to sense of self. Furthermore, I offered ways that digital jewellery can potentially support a person during the journey between two countries and the impact of this journey on senses of self. The liminal spaces of airplanes and airports offer a rich context for digital jewellery and design opportunity that can be researched in further work.

To conclude this thesis, I offer some thoughts from a workshop I ran with a small group of jewellery students at the University of Applied Sciences in Lucerne in October 2018. I was invited by the professor and jeweller Christoph Zellweger to run a masterclass on my work on digital jewellery and its poetic qualities. In the workshop, I discussed with the student's examples of digital jewellery (including my pieces) and I presented the design framework that I have developed within this PhD. Students were asked to apply the framework and make their own examples of digital jewellery via having a focus on the qualities of the form, interaction and the function of their pieces. The results were inspirational to the group and a great opportunity for me to reflect upon how my work and my theoretical framing can benefit jewellers. Further reflections will be valuable to the community and will be part of my further research. Pictures from the workshop (see Appendix C. p.291) will give the reader an idea of what happened during the workshop and hopefully open further discussions on the role of digital jewellery within both our practice

and higher education.

I believe that there is a more work to be done in the field via continuing research in digital jewellery from a range of perspectives. If there is one piece of advice that I would give to contemporary jewellers it would be digital technology brings challenges that are new to the field and a multi-disciplinary approach in making digital jewellery in necessary. I believe that even though this thesis focuses on digital jewellery, design researchers can also learn from the different ways of designing personal meaningful objects that can support sense of self.

7.1 Next steps and Future work

One of my next steps is to continue developing digital jewellery that can support sense of self. Specifically, it would valuable to work with a range of different people to see how digital jewellery supports different members of the public as they are going through transitions in their life (short-term or life transitions). I also want to develop robust prototypes that can be tested in real world situations in order to gather data about real world use and the impact of digital jewellery on peoples' everyday lives. I hope that my next steps in research will allow me to continue researching digital jewellery and apply my creativity and sensitivity in working with people on a personal level and empirically explore how they live with digital jewellery over time. It is important for my future research to contribute in designing digital jewellery pieces that becomes meaningful in lived experience and through life transitions.

Alongside this investigation, I want to open more conversations on conceptions and experiences with digital jewellery within the jewellery realm and discuss the relevance of digital technology as a material within the field of contemporary art jewellery. Jewellery school with digital making labs are in infancy but still sparse.

I hope in the years to come more conversations on digital jewellery will be taken place within art schools. I hope I will be given the opportunity to inspire and educate new generations of jewellers and frame design inquires in this emerging research era of digital jewellery.

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