# DESIGNING MEANINGFUL OBJECTS

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Doctorate of Philosophy

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2019

# UNIVERSITY OF TECHNOLOGY SYDNEY

## Certificate of Original Authorship

I, Daniel Orth declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctoral degree, in the Faculty of Engineering and Information Technology at the University of Technology Sydney. This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis. This document has not been submitted for qualifications at any other academic institution. This research is supported by the Australian Government Research Training Program.

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Daniel Orth
12 May 2019

# MATERIALISING MEMORIES

This thesis was completed as part of the Materialising Memories research program under the supervision of Professor Elise van den Hoven and Dr Clementine Thurgood. Materialising memories is a research program that investigates the effects of physical and digital media on memories in everyday life. It explores how personal media, such as photos, audio and visual recordings, are used and why people want to relive or forget memories. Using a design research approach, Materialising Memories investigates how physical and digital media can support and facilitate remembering and forgetting in the everyday, particularly during and after major life events, and for those with memory impairments. The program investigates remembering and forgetting—both results of the same process.

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# ACKNOWLEDGEMENTS

I would first like to thank everyone who participated in this research and openly shared their unique thoughts and experiences. Without your valued input, this research would not have been possible. I'd also like to thank the University of Technology Sydney for providing financial support through their Doctoral Scholarship program that allowed me to do this research.

Thank you to my supervisors for your ongoing guidance, support and much needed encouragement. To Elise, for showing me the rewarding value of design research and encouraging me to pursue this endeavour. To Clementine, for bringing sincere enthusiasm to the research and always finding time to discuss my work. You have both served as inspiring role models for my own professional development. I would also like to thank the rest of the Materialising Memories team, both in Australia and abroad for warmly welcoming me and for all the insightful discussions we had over the years. Special thanks to Joe for sharing your unique perspective of design and research. I particularly enjoyed collaborating with you and being a part of your research projects. Further thanks go to Clayton for taking a chance on hiring me as a designer, continually being supportive of my research pursuits and instilling a work ethic without which, this thesis may have taken twice as long.

I'd also like to thank my family for always being there for me. To my mum and dad for encouraging me to pursue my own interests and being unconditionally supportive of the choices I make. To my siblings, Jared, Domonique, Kyle and Jordan for helping in any way you could and sharing much needed down time outside of the PhD. Finally, thank you to Shirley for always reassuring me and making each milestone a celebration. You make every day better than I could hope for.

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# ABSTRACT

This doctoral thesis investigates the ways in which designers can create both physical and technological objects that are meaningful for their users. Through four empirical studies, this research project generated insights into the relationship between meaningful objects and a person's self-identity, the differences between attachments to physical and technological products and the ways in which objects are imbued with personal meaning. These insights informed the development and evaluation of a design strategy for promoting product attachment. The strategy involves a process of designing objects with material or interactive properties that are associated with concepts that have been identified as meaningful to the intended user. The process was implemented and evaluated with evidence indicating it brought meaning to the resulting designs in several instances. Insights highlighting the unique characteristics of attachment experiences between people and their technological possessions were used to adapt and subsequently re-evaluate the value of the design process in the development of technological products. Critical reflections on the process and resulting design reaffirmed the potential value of designing objects with meaningful associations as a strategy for promoting product attachment in the digital age and combating unsustainable material consumption.

# 1

# INTRODUCTION

Crafted objects have played a significant role in the lives of humans and their ancestors for over a million years. The earliest species of our genus are widely referred to as *Homo habilis*, meaning *handy man*, in reference to their prominent use of stone tools for tasks such as carving, skinning, boring and engraving. Beyond their function as resourceful tools, human-made objects have long-held personal and cultural significance that echo the values of the societies they belong to. This expansive shared history between humans and objects speaks to the centrality of their role in our lives not just as a means of enabling us to complete complex tasks, but as a source of meaning. This research thesis deals with the subset of objects that are assigned emotional significance. In essence, this thesis explores the ways in which product design practice can influence the internal meaning-making processes in which people develop strong emotional ties to their belongings.

## 1.1 What Makes Objects Meaningful?

We each possess certain objects that are dear to us for a variety of reasons. They can be sentimental to us, bring us delight through their use or empower us. Throughout our lives, we use these meaningful possessions to reaffirm who we were, who we are and who we wish to become. Internal processes that lead us to develop feelings of attachment to an object are often framed within *self-extension* processes (Prelinger, 1959), in which people incorporate other significant people, places and things within their own sense of self (Belk, 1988). This process of *extending the self* aids us in characterising, communicating, maintaining or developing an aspect of our self-identity (Kleine, Kleine, & Allen, 1995; Schultz, Kleine, & Kernan, 1989) and occurs throughout all stages of our lives (Myers, 1985). Through this self-extension process, objects can be considered meaningful for a range of reasons. This includes the enjoyment they provide through their use (Schifferstein & Zwartkruis-Pelgrim, 2008), significant associations to memories, people, beliefs or values that bring about a rich range of emotions (Mugge, Schifferstein, & Schoormans, 2005a), their ability to enable the achievement of goals (Csikszentmihalyi & Rochberg-Halton, 1981), their shared history with a person (Battarbee & Mattelmäki, 2004) or their involvement within a person's life story (Kleine et al., 1995). In these ways, objects are often considered meaningful for traits beyond their own materiality, extending to their links to aspects of the self or life narrative of an individual.

The study of emotional bonds between a person and an object is primarily framed within the construct of attachment (Bowlby, 1977). These studies further clarify the properties of attachment experiences. The meaningfulness of a particular object is likely to change with the passage of time (Schultz et al., 1989). A once loved toy may become meaningless as it portrays an outdated version of the self (Kleine et al., 1995). Conversely, the meaning assigned to a wristwatch may develop slowly over time through its shared history with the owner (Page, 2014). The strength of attachment to a possession may also be influenced by the ageing of the product itself or the emergence of new fashion trends and technological improvements (Schifferstein & Zwartkruis-Pelgrim, 2008). Emotional ties formed between people and objects often occur at varying levels of abstraction. Distinctions have been made between attachments to a specific object (Mugge, 2007) versus a product category (Bloch, 1982), brand (Thomson, MacInnis, & Park, 2005) or

possessions in general (Belk, 1988). Each of these forms of attachment manifest in the assignment of meaning to particular objects. In many cases, these various forms of attachment are interrelated in their contribution to the overall meaningfulness of a possession (Crilly, Moultrie, & Clarkson, 2004).

To provide a more concrete picture of what we consider to be a *meaningful object*, we provide the example of the named author's meaningful leather wallet (Figure 1).

**Figure 1. My Lacoste bifold wallet.**

*I was given this wallet as a birthday gift from my partner when we first started dating eight years ago. Over time, the wallet has come to signify the wealth of fond moments we have shared throughout our relationship. But it has also come to be a highly personal item. I take it with me every time I leave the house. I appreciate the design of it. The subtle brown leather body and vibrant blue and white striped internal lining (which is only seen by me) make it feel all the more unique. It also has a simple construction with just the right number of slots for the cards I carry. Looking at it makes me think of positive moments in life such as going out for drinks with friends. When I feel its presence in my pocket, I get a slight sense of relief knowing I have it with me. It's meaningful to me for all these reasons and more.*

This example illustrates the innately personal nature of a meaningful object. One person may consider an object highly meaningful, whilst others may see the same object as a meaningless commodity. Chapman (2014b) describes this phenomenon by stating *"material things do not contain meaning, but rather, they trigger meaningful associations within the perceiver"* (p. 142). Objects cannot be inherently meaningful, but rather they become meaningful when they are assigned personal significance by an individual.

## 1.2 How Can Designers Influence Object Meaningfulness?

Most designers wish to create things that people come to love, but to what extent can design practice make an object meaningful? Many studies have explored the potential role of design in the development and creation of meaningful objects (e.g. Chapman, 2009; Desmet, Overbeeke, & Tax, 2001; Gegenbauer & Huang, 2012; Lacey, 2009; Mugge, Schoormans, & Schifferstein, 2008; Norman, 2004; Zimmerman, 2009). Inciting people to engage in meaning-making processes has been found to be a challenging and fickle design objective (Desmet et al., 2001; Niinimäki & Koskinen, 2011). Simply put, there are a number of factors involved in the development of attachments that are beyond a designer's control. Evaluative responses to products are ephemeral and unique to the individual, limiting designers to create possibilities instead of certainties in any attempts to cue personal meaning (Hassenzahl, 2004). Despite these barriers, the goal of designing meaningful objects remains an active interest in researcher and practitioner communities due to the broad merit in doing so.

To work towards enabling designers to influence object meaningfulness, several design strategies have been derived from identified determinants of product attachment. Proposed strategies include designing products that evoke enjoyment (Schifferstein & Zwartkruis-Pelgrim, 2008), stimulate social contact (Mugge, Schoormans, & Schifferstein, 2005), encourage the formation of product-related memories (Odom & Pierce, 2009) or allow consumers choice within a set of objects (Lacey, 2009). These strategies provide guidance for designers seeking to promote product attachment through their practice, but in many cases are yet to be applied within design practice.

Notable examples of designs that attempt to influence object meaningfulness include the *Stain* teacup by Wood (2006) shown in Figure 2 and a set of custom roller blinds by Finnish textiles company Oy Vallila Interior Ab (Niinimäki & Koskinen, 2011) shown in Figure 3. The interior surface of the teacup is treated in such a way to stain more in predetermined places. Through repeated use of the teacup a pattern is slowly revealed, creating mindful moments of interaction and an appearance that signifies the user's personal drinking habits as it ages. Oy Vallila Interior Ab's custom roller blinds shown in Figure 3 draw inspiration from the customer's grandfather's letters, creating intimate associations with the user's family heritage. These examples illustrate the diverse possibilities within design practice to explore means of fostering the development of meaningful relationships between users and objects.

**Figure 2. Stain teacup by Wood (2006).**

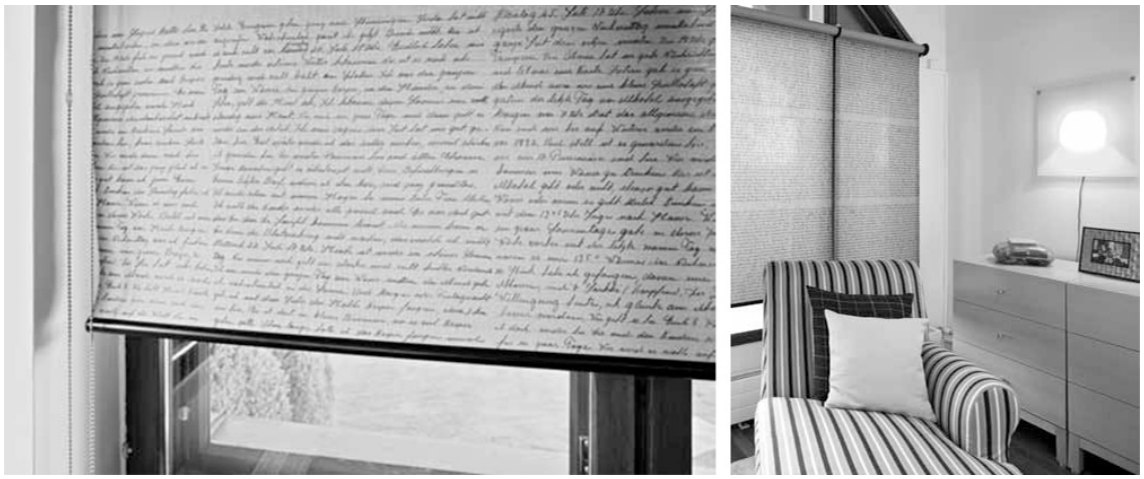

**Figure 3. Roller blinds by Oy Vallila Interior Ab (as cited in Niinimäki & Koskinen, 2011).**

## 1.3 Research Motivation

The topic of product attachment has received significant attention from a number of research fields including psychology, sociology, material culture, consumer behaviour, HCI and design with substantial contributions made in understanding why and how people come to ascribe meaning to their belongings (see Belk, 1988; Csikszentmihalyi & Rochberg-Halton, 1981; Miller, 1987; Myers, 1985; Schifferstein & Zwartkruis-Pelgrim, 2008; Verbeek, 2005). This array of perspectives examining meaningful human-object relationships reflects the widespread potential benefits associated with a greater understanding of both the nature of the relationship and the applicability of design strategies to foster its development. The shifting nature of product manufacturing, design and material consumption practices culminate in a number of issues relevant to the process of ascribing meaning to objects that warrant further exploration.

### 1.3.1 Meaningful Objects and Self-Extension

The study of ways in which people develop attachments to their belongings has played an integral role in advancements in identity theory (Belk, 1988; Kleine et al., 1995; Myers, 1985). It is widely understood that people develop attachments to certain objects for their role in the construction, maintenance or development of an aspect of their self-identity (Ball & Tasaki, 1992; Csikszentmihalyi & Rochberg-Halton, 1981; Schultz et al., 1989; Wallendorf & Arnould, 1988). A well-documented example of this studied by identity theorists is seen in the relationship an infant develops with a particular doll or blanket. These objects augment the calm and comfort provided by a parent, soothing the infant during their absence. Through usage of the doll or blanket, the infant develops the ability to soothe themselves and grow beyond the need for an external soother (Tolpin, 1971). Throughout our lives, we continue to engage with objects to facilitate self-development processes in a variety of ways. This can be seen in a pair of running shoes that help develop an *athlete* identity or a pram used to characterise a *parent* identity.

Technological advancements rapidly brought about changes to the nature of objects that have now become prevalent in our daily lives. The transition towards products containing digital or computational functions has influenced the relationships we form with our belongings and the self-developmental processes we engage in through these relationships (Borgmann, 1984). Recent studies have found that people often do not value

their digital or physical-digital possessions as highly as their physical possessions (Golsteijn, van den Hoven, Frohlich, & Sellen, 2012; Odom & Pierce, 2009; Odom, Zimmerman, & Forlizzi, 2014; Petrelli & Whittaker, 2010). The underlying causes for these differences in emotional value are not yet fully understood. This may be partly due to the increased difficulty of defining and segregating personas and identity roles through the use and ownership of possessions in digital contexts (Belk, 2013). For example, a teenager may restrict the content shared in a Facebook profile as it can be viewed by multiple audiences such as their friends and parents (Odom, Zimmerman, & Forlizzi, 2011). Recent changes to object forms and the resulting effect of these changes to the ways in which individuals use objects for self-extension purposes has brought about the need for a greater understanding of the development of attachments in digital contexts. In addition to this, there is a need for generating insights to inform the design of technological products to promote the formation of meaningful human-object relationships to ensure objects continue to enable self-extension processes.

### 1.3.2 Meaningful Objects and Sustainable Consumption

The lifespan of manufactured objects has been an established interest in design research for many years (Packard & McKibben, 1963) and more recently has received greater attention in the field of Human-Computer Interaction (HCI) (Gegenbauer & Huang, 2012; Huang & Truong, 2008; Odom, Pierce, Stolterman, & Blevis, 2009). This interest predominantly stems from sustainability concerns for the rate of resource consumption caused by processes involved in the manufacture, distribution, use and disposal of products. In the past three decades, we have consumed one-third of the planet's resources (Hawken, Lovins, & Lovins, 2013). Product longevity has been argued to be a core factor of the environmental impact of products (Verbeek & Kockelkoren, 1998) with growing attention being given to formulating solutions to address these issues, illustrated by the recent inception of the Product Lifetimes and the Environment (PLATE) conference in 2015. Causes for the short lifetime of products often point towards problems in our throwaway culture rather than the durability of the products themselves (Chapman, 2008; Cooper, 2002; Huang & Truong, 2008; Odom et al., 2009; van Nes, 2003). Promoting the development of attachment towards products through design has been considered as a viable strategy to address issues with the rate of product consumption by delaying

disposal or replacement (Chapman, 2008; Gegenbauer & Huang, 2012; Huang & Truong, 2008).

### 1.3.3 Meaningful Objects and Design Practice

Making objects that people come to love is a goal shared by many product designers. Achieving this goal provides a wide range of benefits that appeal to consumers and businesses alike. Attachments to products can empower individuals in developing and maintaining a coherent sense of self (Wallendorf & Arnould, 1988), provide self-expressive opportunities (Mugge, Schifferstein, et al., 2005a), increase enjoyment (Schifferstein, Mugge, & Hekkert, 2004) and care (Belk, 1991) while interacting with a product, extend the product's lifespan (Chapman, 2009), increase brand loyalty (Reed, Forehand, Puntoni, & Warlop, 2012) and increase life satisfaction (Sherman & Newman, 1978). Attending to the ways in which the designed material and interactive properties of a product elicit certain evaluative responses for individuals has been the predominant focus of efforts to promote meaningful human-object relationships (Hekkert & Cila, 2015; Mugge, Schoormans, et al., 2005; Zimmerman, 2009). However, it remains a difficult task to influence people's internal processes involved in developing feelings of attachment towards a belonging. Experiences of attachment are unique to the individual (Niinimäki & Koskinen, 2011) and a single product will elicit different levels of emotional value amongst different users (Desmet et al., 2001). Little progress has been made in applying design strategies derived from attachment theory to design practice to effectively promote the development of attachment among users. Further practice-based exploration of established insights outlining the nature of product attachment can aid in bridging this gap between theory and practice.

### 1.3.4 Personal Motivation

On a more personal note, this research project is motivated by a strong belief in the potential of design practice to address complex issues in ways that fulfil both human and environmental needs. After working as an industrial designer for several years, this project provides an opportunity to more deeply explore the potential for industrial design practices to address a fundamental issue resulting from its output—unsustainable consumption. Many people understand the need for changes to our current usage of natural resources and consumption behaviours but find steps towards consuming less to be an exercise of *restraint* (myself included). Chapman (2014b) describes material consumption as behaviour that is *"motivated when discrepancies are experienced between actual and desired conditions"* (p. 139). The premise of designing meaningful objects is that more sustainable material consumption can be achieved without asking people to *sacrifice* but rather, through thoughtful design, people can possess products that they love deeply and have no desire to replace or throw away. In addition, loved products motivate people to treat them with care and repair them when they are damaged, further extending their functional lifetime. Beyond the need for changes to our consumption behaviours, designing meaningful objects enriches the lives of the people being designed for, a goal that is worthy in its own right.

## 1.4 Research Objectives

The central objective of the research described in this thesis was to provide insight into the ways in which product designers can promote the formation of meaningful human-object relationships through their practice. The previous sections of this chapter have outlined the primary issues involved in this objective. To appropriately consider these complex issues, we adopted a cumulative method of exploring the following research questions:

**R1.** How do meaningful objects relate to an individual's self-identity?

**R2.** How can designers create objects that relate to an individual's self-identity?

**R3.** How do meaningful physical-digital objects relate to an individual's self-identity?

**R4.** How can designers create physical-digital objects that relate to an individual's self-identity?

The research conducted in this thesis is explorative in nature. Our cumulative approach to addressing the central research objective intends to provide greater focus and structure within our explorations. Emphasis is given to the relationship between objects and the individual's self-identity as this link is a defining feature of product attachment (Ball & Tasaki, 1992; Kleine & Baker, 2004; Schultz et al., 1989; Thomson et al., 2005). Attention is given specifically to physical-digital objects as they are a widely prevalent and rapidly growing subset of objects that are less likely to elicit feelings of attachment amongst users (Golsteijn et al., 2012; Odom & Pierce, 2009; Odom et al., 2014; Petrelli & Whittaker, 2010).

## 1.5 Research Approach

The central topics of this thesis have been heavily explored in a number of research fields including psychology, sociology, consumer behaviour, material culture, design and HCI. While an understanding of this range of literature is valuable for building upon the topic area, its breadth limits the depth of understanding achievable in the scope of this project. Therefore, the research involved in this thesis will not be from the perspective of an expert of all associated fields, but rather as a design researcher combining aspects from each of these areas of research to inform the development and application of insights for designing meaningful objects.

Relationships between people and objects can be both personal and social. In many cases, an object can contain *shared meaning* among a group of people (e.g. a family), representing aspects of their relationship to one another (Petrelli & Whittaker, 2010). This thesis focuses on human-object relationships at the personal level. While the reasoning for an individual's attachment to an object can be social in nature, connecting them to others, there is a distinction to be made between this experience and an object collectively valued by a family or community. Research detailed within this thesis centres on individual experiences of attachment. As such, it primarily addresses the subset of personal consumer products found within the home such as jewellery, sculptures, clothing, furniture and electronic devices.

### 1.5.1 Theoretical Framework

This thesis explores the ways in which design practice can facilitate the development of meaningful human-object relationships. As a basis for understanding the nature of these relationships, we draw upon research related to attachment theory and identity theory. Several advancements in identity theory have influenced product attachment theory due to the closeness of these two areas of research. This includes the structuring of a person's sense of self as a life narrative (McAdams, 1985) in which moments from our past, present and anticipated future are connected to construct a coherent life story that reflects who we are as a person. Products often gain emotional significance for their involvement in a person's life story (Kleine et al., 1995). This includes products that reflect a person's autonomy as a unique individual, their affiliations to friends and family, fond recollections of the past or their hopes for the future. The link between meaningful objects and the self

has become an established insight in a number of disciplines (e.g. Belk, 1988; Csikszentmihalyi & Rochberg-Halton, 1981; Miller, 1987; Myers, 1985). In the context of physical-digital objects, findings from the field of Human-Computer Interaction (HCI) have distinguished between attachment to a *thing* versus attachment to what it *provides*, bringing to light emerging issues related to the abstraction of attachment experiences with the introduction of digital functionality within physical objects (Feinberg, 2013; Golsteijn et al., 2012; Kirk & Sellen, 2010; Odom et al., 2009).

As a basis for developing appropriate means of applying insights derived from attachment and identity theory to design practice, we draw upon work from the fields of design and HCI. More specifically, this thesis follows applied research related to product design and interaction design that are in some cases informed by findings from the areas of sustainable design and the broader HCI community. Objectives of the research detailed within this thesis are primarily intended to provide insights to product designers navigating emerging trends within the discipline that call for more sustainable product consumption and greater integration with digital technologies. As more aspects of our lives move towards the digital realm, interactive functions are becoming increasingly central to the field of product design (Vallgårda & Redström, 2007). Conversely, the field of interaction design is becoming increasingly focused on the material aspects of interaction, with designers breaking away from screen-based solutions (Wiberg et al., 2013). The merging of product and interaction design practices requires a balanced perspective, acknowledging the relevance of research exploring the materiality of traditional consumer products and interactivity of computational devices.

### *Definitions and Terminology*

The definitions and terminology used to describe meaningful human-object relationships varies greatly within and across the various disciplines that explore its properties. We adopt the definition of *product attachment* as *"the extent to which an object which is owned, expected to be owned, or previously owned by an individual, is used by that individual to maintain his or her self-concept"* (Ball & Tasaki, 1992, p. 158). The terms *self-concept* and *self-identity* are synonymous and refer to the mental image a person has of themselves in relation to their qualities, beliefs, personality, appearance and values. This mental image includes their past, present and anticipated future selves that describe who they were, who

they are and who they are becoming (Kleine et al., 1995). Related to this, we use the term *association*s to refer to mental connections between concepts, events and mental states (Klein, 2011). Objects are often considered meaningful for their association to an external source of meaning (Csikszentmihalyi & Rochberg-Halton, 1981), such as a kitchen knife that is associated with sharing meals with friends and family.

Possessions that a person feels attachment towards are interchangeably described as meaningful (Denegri-Knott, Watkins, & Wood, 2012), cherished (Csikszentmihalyi & Rochberg-Halton, 1981), emotionally significant (Meschtscherjakov, Wilfinger, & Tscheligi, 2014), favourite (Schultz et al., 1989; Wallendorf & Arnould, 1988), loved (Ahuvia, 2005) or special (Petrelli & Whittaker, 2010). We primarily use the term *meaningful* to describe an external entity (e.g. an object, experience, event, place or person) that an individual feels attachment towards and therefore considers as an extension of their self-identity. Our usage of the term *meaningful* is restricted to describing something that is linked to an individual's self-identity and does not encompass broader interpretations of the term as synonymous to describing something as *memorable*, *emotive* or *mindful*.

We provide an overview of the relationship between *self-identity*, *attachment* and *meaningfulness* in Figure 4. If an external entity (e.g. an object, experience, event, place or person) is associated with a significant part of a person's self-identity, then it is *meaningful* to that person. *Attachment* describes the strength of the link between a person's self-identity and an external entity. Therefore, if something evokes strong feelings of attachment, it is considered to be meaningful. Conversely, if something does not evoke any feelings of attachment, it is considered to be meaningless.

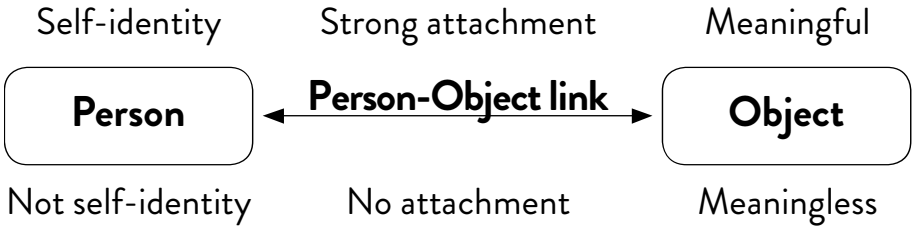


**Figure 4. Relationship between self-identity, attachment and meaningfulness.**

The above figure illustrates the close relationship between meaningfulness and attachment as central terms throughout this thesis. In the work detailed within this thesis, we opt to discuss *meaningfulness* with our research participants instead of the more

commonly used notion of *attachment* to better accommodate comparative discussion of physical and digital belongings. Studies measuring product-related attachments have traditionally assessed responses in relation to the criteria of *irreplaceability* (Kleine et al., 1995; Schifferstein & Zwartkruis-Pelgrim, 2008; Schultz et al., 1989). This can be problematic when comparing the personal significance of physical and digital belongings as the irreplaceability of a digital possession can be difficult to conceptualise (Feinberg, 2013) and may unduly influence participant responses.

Terminology used in literature to distinguish the nature of a *thing* itself is often divergent. We refer to three categories of products based on Kirk and Sellen's (2010) format classification. *Physical objects*, also referred to as non-digital artefacts (Turner & Turner, 2013) (e.g. a coffee mug or chair), *digital items*, also referred to as digital objects (Golsteijn et al., 2012), digital goods (Denegri-Knott et al., 2012) or virtual possessions (Odom et al., 2014) (e.g. an email, photo or app) and *physical-digital objects* that are physical objects containing digital information, also referred to as hybrid objects (Golsteijn et al., 2012), digital artefacts (Odom & Pierce, 2009) and technological artefacts (Kirk & Banks, 2008) (e.g. a smartphone, MP3 player or desktop computer). The terms *physical-digital* and *technological* are synonymous in this thesis when used to describe a product, as are the terms *physical, material* and *tangible*. We also interchangeably use the terms *product, object, possession* and *device* depending on our emphasis of its *manufactured*, *tangible*, *owned* or *technological* properties. While the idea of *digital materiality* has been explored in recent years (Jung & Stolterman, 2012; Leonardi, 2010), we use the term *materiality* in the traditional sense to refer to the quality of being composed of matter.

### 1.5.2 Methodologies

The research detailed within this thesis explores the relationship between designed objects and a person's self-identity. We adopt qualitative research methods to focus our attention on the richness of individual experiences that characterise meaningful human-object relationships. The combination of methodologies deployed to address this topic are derived from either the practice of designing objects, understanding a person's sense of self or mediating a relationship between the two areas. In this section we provide an

overview of each of the adopted methodologies and outline their relevance to our research objectives.

### *Life Stories*

A person's mental image of themselves is both complex and highly personal, involving ties to their unique individual experiences throughout their lifetime. These experiences are connected to construct a coherent life narrative (McAdams, 1985) that contains both continuity and change brought about by ongoing development of the self (Kleine et al., 1995). Narrative inquiry methods use stories expressed in various forms as units for data collection and analysis to understand the ways in which people create meaning in their lives. Among these methods are semi-structured interviews that discuss a person's life story. These interviews provide an in-depth study of individual lives with an emphasis on the uniqueness of personal experiences. Life stories are ideal for the study of meaningful aspects of a person's life as they *"express our sense of self"* (Linde, 1993, p. 3). A life story is a social unit exchanged between people through conversation and the re-telling of past experiences. As such, they are *reconstructions* of a person's experiences that are both subjective and fragmented in nature (Polkinghorne, 1995). Life stories are not just the retelling of specific autobiographical memories, but involve the construction and expression of life chapters, e.g. *my childhood,* that summarise broad periods of time or ongoing aspects of the person's life, e.g. *my career* (Thomsen, 2009). We use life stories to gain a sufficiently rich understanding of an individual's self-identity to inform design processes that seek to influence internal meaning-making processes.

### *Research through Design*

The discipline of design is primarily a generative endeavour, creating new systems, experiences and things that address particular needs and desires. This generative approach positions the field to be looking forward towards the future with interest in new ways of shaping change in the world around us. Research through design (Frayling, 1993) has become a common method adopted by design and HCI researchers aiming to explore new, under-constrained problem spaces through the production of artefacts. Unlike design practices that are centrally focused on the production of a commercial product, research through design primarily acts as a method of producing knowledge to contribute to researcher or practitioner communities. Artefacts produced in research through design

processes are generally not concerned with certain issues such as the economics of commercial viability, yet they may still involve detailed refinement of qualities such as material finish to enable richer insights into the ways in which product properties influence user experiences (Odom et al., 2016). The widely diverse and ill-defined explorations conducted under the research through design framework have raised concerns for their ability to contribute to established theory (Forlizzi, DiSalvo, Bardzell, Koskinen, & Wensveen, 2011). Conversely, the under-constrained nature of research through design processes has been argued to be necessary for producing insights that are useful for practitioners as it holistically considers the complexities and nuances of real life contexts that design practices work within (Stolterman, 2008; Zimmerman & Forlizzi, 2008). Through the production of artefacts and prototypes, research through design approaches allow design solutions to be evaluated in real-life contexts, providing more holistic insights into the application of theory to current or future practice. We adopt a research through design approach to sufficiently consider the complexity of design practice and better evaluate the effectiveness of our developed design strategies for promoting the formation of attachment among intended users.

### *Probe Methodology*

Research within the fields of design and HCI often works towards bridging gaps between theory and practice. Mediating differences between scientific theory and design practice represents a central challenge to the work done by design researchers (Stolterman, 2008). More specifically, there has been criticism for the translation of theory-based knowledge into design guidelines or analytic frameworks that have limited utility in practice (Rogers, 2004). Probe methodologies first developed by Gaver, Dunne and Pacenti (1999) have taken a unique approach to gathering data to better inform design processes, creating packages of maps, postcards and other materials to provoke inspiration responses from research participants. The use of probing methods have since been adapted to a variety of research purposes within the design and HCI communities (Boehner, Vertesi, Sengers, & Dourish, 2007; Mattelmäki, 2006). To address the research objectives of this thesis, we sought to produce insights derived from understandings of a person's self-identity that would effectively inform the practice of designing meaningful objects. To do so, we developed novel research tools and activities to be used for probing purposes that share

similarities to the wealth of studies implementing probe methodology (e.g. Berkovich, 2009; Crabtree et al., 2003; Jung & Stolterman, 2011; Mattelmäki, 2006). Much like design probes (Mattelmäki, 2006), our probing methods were used as agents of dialogue with participants in the form of semi-structured interviews.

### *Multimethod Research*

The research detailed within this thesis addresses the substantial objective of designing meaningful objects, requiring consideration for the ways in which users evaluate designed material and interactive properties and the complex internal processes involved in the assignment of meaning to an external entity. This requires a sufficiently in-depth approach to acquiring rich understandings of these two processes. At the same time, there is also a need for maintaining a holistic perspective of the various relevant factors involved in designing meaningful objects. To address this need for in-depth insight into several interrelated research areas, we adopted a multimethod approach. In doing so, we limit the sample of participants present in the conducted studies but see this to align with our aims to account for the richness of individual experiences rather than produce generalisable theory, much like Denegri-Knott, Watkins & Wood (2012).

### *Thematic Data Analysis*

Contributions to knowledge in the domain of product attachment have taken a broad range of perspectives to managing the dichotomy between the uniqueness of individual attachment experiences and the pursuit of findings that are broadly relevant. In particular, measuring or evaluating attachment remains a complex and ill-defined area of research. Studies attempting to do so have adopted a variety of methods, including Q-Methodology (Kleine et al., 1995), questionnaires (Ball & Tasaki, 1992; Dyl & Wapner, 1996; Ferraro, Escalas, & Bettman, 2011; Schifferstein & Zwartkruis-Pelgrim, 2008; Schultz et al., 1989; Thomson et al., 2005; Weiss, Wurhofer, & Tscheligi, 2009), interviews (Csikszentmihalyi & Rochberg-Halton, 1981; Denegri-Knott et al., 2012; Kirk & Sellen, 2010; Lacey, 2009), focus groups (Golsteijn et al., 2012; Wallendorf & Arnould, 1988), deep narratives (Jung, Bardzell, Blevis, Pierce, & Stolterman, 2011) and non-verbal self-report instruments (Desmet, 2003a). While tools have been developed to evaluate people's emotional reactions to products (e.g. Desmet, 2003a; Kujala & Nurkka, 2012), evaluating the effectiveness of designed artefacts in fulfilling goals related to the

formation of attachment remains a difficult challenge for design researchers. This is primarily due to product attachment being a highly variable experience and often taking several years to develop among users.

In the analysis of studies included in this thesis, we derive insights from interview data, responses to our probing activities and reflections on our design processes. Empirical data obtained from engagements with participants is analysed thematically, with broader conclusions also drawing from our own reflections and resulting interpretations of the various forms of data. Thematic analysis allows for comparisons between participant perspectives to generate themes that capture patterned responses or meaning from within the data set that hold relevance to the research question (Braun & Clarke, 2006). Data is coded following an *inductive* approach in which resulting themes are strongly linked to the data themselves and emerge without the use of a prior coding frame. From this, we produced detailed accounts of particular themes that related to our specific research questions, rather than providing a description that accurately reflects entire data sets. This approach to the analysis of data intends to produce findings that are by no means definitive, but instead maintain the richness and diversity of individual experiences that characterise both meaningful human-object relationships and the heterogeneous nature of design practice.

## 1.6 Thesis Structure

This thesis presents a series of empirical studies that cumulatively explore ways in which product designers can promote the formation of meaningful human-object relationships through their practice. Chapter 2 presents a review of literature that discusses product attachment, a construct that is central to understanding the role and meaning of possessions to their owners. It also provides a review of the shifting nature of designed products due to technological change and the ways in which designers can influence attachment experiences. Chapter 3 presents a study exploring the relationship between meaningful possessions and self-identity to identify opportunities for design intervention through the deployment of several probing activities and evaluative interviews. Chapter 4 details the design process and evaluation of six physical products intended to form links to an individual's life narrative as a means of promoting product attachment. The following chapters then build upon these insights to consider products containing digital functionality and the effects this has on attachment experiences. Chapter 5 explores the ways in which the physical-digital nature of an object influences the relationship it forms with a person's self-identity. Chapter 6 then details the design process and evaluation of *Melo*, an interactive music player intended to possess materiality that is meaningful for its user. In Chapter 7, we summarise the key contributions of the thesis, outline a design strategy for promoting product attachment and discuss several issues related to designing meaningful objects that emerged through reflecting on the findings of our four empirical studies. Finally, we conclude by summarising the empirical studies conducted to address the four research questions outlined previously in this chapter.

# 2

# OVERVIEW OF OBJECT MEANINGFULNESS

This chapter provides a review of literature relevant to understanding object meaningfulness and its relationship with product design practice. We draw upon research findings from psychology, consumer behaviour, design and human-computer interaction to provide an overview of the insights and gaps in our understanding of appropriate means for designing meaningful objects. This includes an overview of the construct of product attachment, why it occurs, and what effects it has on human-object relationships. It also addresses the nature of relationships between people and their digital or physical-digital belongings to consider the impact of digital functionality on product attachment experiences. Finally, a number of design strategies and examples are analysed to explore how designers can promote the formation of attachment within their designs.

## 2.1 Meaningfulness and Attachment

Through our engagement with the world in which we live, we as humans develop meaningful relationships with things external to ourselves. These relationships can bring about a wealth of emotional responses that connect us with places, people, experiences, activities and things. A part of this engagement with the world results in each of us possessing objects that hold sentimental value, bring delight through their use, empower us to engage in fulfilling activities, remind us of our past or reflect our ties to friends and family. They bring continuity to our lives, reaffirming who we were, who we are, and who we wish to become. Over time, we develop attachments to these objects and come to value them dearly.

### 2.1.1 Differentiating Meaningfulness and Attachment

In the previous chapter, we outlined the relationship between self-identity, attachment and meaningfulness. To reiterate, *attachment* describes the strength of the link between a person's self-identity and an external entity (such as an object, experience, event or place). This external entity then holds the characteristic of being *meaningful* to that person. *Meaningfulness* therefore relates to the aspects of a person's sense of self that they consider to be significant. While these terms relate to the same internal processes in which humans assign meaning to things external to themselves, literature addressing these processes often frame their inquiry through exploring either the *link* known as attachment (see Ball & Tasaki, 1992; Mugge, 2007) or the meaningful *thing* itself (see Csikszentmihalyi & Rochberg-Halton, 1981; Verbeek & Kockelkoren, 1998). Due to the almost synonymous nature of these constructs, we amalgamate these two lenses of inquiry in our exploration of ways in which designers can create meaningful objects.

### 2.1.2 Definition of Product Attachment

Attachment has been broadly defined as an emotional-laden bond connecting an individual with a specific target (Bowlby, 1977). Greater complexity arises when attempting to define the nature of the target itself. Product attachment relates to the emotional ties that form between individuals and objects. This specific instance of attachment has been the focus of literature in the fields of psychology, sociology, material culture and consumer behaviour (e.g. Belk, 1988; Csikszentmihalyi & Rochberg-Halton,

1981; Myers, 1985). There is a level of agreement across these fields regarding the strong ties between people forming attachments to things and the ways in which humans construct, develop and maintain a sense of self. Belk's advancement of the notion of the *extended self* in which an individual's sense of self extends beyond *what is me* to *what is mine* has become a central component of product attachment theory. We adopt the definition of product attachment *as "the extent to which an object which is owned, expected to be owned, or previously owned by an individual, is used by that individual to maintain his or her self-concept"* (Ball & Tasaki, 1992, p. 158). This definition positions product attachment as a result of *self-extension*, a process in which individuals include significant people, places and things within their sense of self (Belk, 1988).

While this view of attachments as *self-extensions* is shared by several researchers (see Kleine & Baker, 2004; Kleine et al., 1995; Schultz et al., 1989; Thomson et al., 2005; Wallendorf & Arnould, 1988), it has also been contested, with some researchers instead seeing product attachment and self-extension as two similar yet separate concepts (Mugge, 2007; Schifferstein & Zwartkruis-Pelgrim, 2008). This contention is argued on the basis that while products valued for their utilitarian meaning can be regarded as self-extensions (Prelinger, 1959), they are not necessarily forms of product attachment. In contrast to this, several empirical studies have identified utilitarian value as a source of product meaning and a determinant for product attachment (Csikszentmihalyi & Rochberg-Halton, 1981; Richins, 1994). We see product attachment as a subcategory of attachment that fits within the broader scope of self-extension processes. The contention raised by both Mugge (2007) and Schifferstein and Zwartkruis-Pelgrim (2008) highlights the importance of clearly delineating between subcategories of attachment when conducting product-related research. Product attachment denotes the emotional ties between a person and a specific object, however people may also feel attachment towards a product category (Costley, 1988), brand (Fournier, 1998) or possessions in general (Belk, 1988). These other forms of attachment similarly relate to human-object relationships but signify different forms of consumer behaviour (Kleine & Baker, 2004).

Product attachment contains a number of properties that further clarify it as a unique construct. First, it denotes the emotional bond between an individual and a specific product. The product is perceived to hold a unique, singular meaning that cannot be replaced, even with an exact replica (Grayson & Shulman, 2000). This singularity is

illustrated by the unlikelihood of someone agreeing to swap their wedding ring or childhood teddy bear, even when the alternative is superior to their own (Belk, 1988). Second, product attachment relates to the emotional ties that form between users and their belongings (Mugge, Schifferstein, et al., 2005a). These ties trigger an emotional response to the object that range from highly positive to highly negative. Products that people feel strongly attached to often evoke positive emotions such as happiness, love, warmth, pride and security (Schultz et al., 1989) but may also evoke negative emotions such as the grief experienced when engaging with an heirloom passed on from a deceased loved one. Third, attachment has the property of strength (Kleine & Baker, 2004). Several studies that examined people's relationships with their *most* cherished possessions (Csikszentmihalyi & Rochberg-Halton, 1981; Wallendorf & Arnould, 1988). Kleine, Kleine and Kernan (1995) found that strong attachments reflect aspects of the self-concept more than weak attachments. Finally, the experience of attachment is temporal and continuously changing over time (Schultz et al., 1989). As attachments are a result of self-extension, their significance directly relates to the self-developmental processes that occur throughout a person's life (Myers, 1985). A once loved toy may become meaningless over time as it portrays an outdated version of the self (Kleine et al., 1995). Conversely, the meaning assigned to a watch may evolve over time through its shared history with the owner. The emotional value of a possession is also likely to change over time due to changes in the product itself such as a loss of functionality and ageing appearance or changes in the environment such as emerging fashion trends and technological improvements (Schifferstein & Zwartkruis-Pelgrim, 2008). While the formation of attachment often develops over an extended period of time through ongoing interactions (Page, 2014) an object may also evoke an immediate emotional response. This can occur as a family heirloom is passed down through the generations or in response to the receipt of a thoughtful gift from a loved one (Kleine et al., 1995).

### 2.1.3 Constructs Related to Product Attachment

In understanding the construct of product attachment, it is important to establish its conceptual boundaries. This is particularly significant when exploring product attachment from a design perspective. By establishing clear boundaries to the construct of attachment, the outcomes that can or cannot be expected from its realisation are similarly established.

While people can experience attachments to other people (Bowlby, 1977), places (Low & Altman, 1992) and experiences (Kleine & Baker, 2004), we focus specifically on constructs related to the emotional ties formed between people and objects. The related constructs to follow are conceptually distinct from product attachment primarily in the level of abstraction in which meaning is assigned to the target.

### *Brand Attachment*

Brand attachment relates to the emotional bond between an individual and a specific brand (Thomson et al., 2005). This extends across different categories of products associated with the brand that may vary significantly in both function and form and to newly released and upcoming models within a product line. Strong degrees of brand attachment can also lead to greater consumer loyalty and willingness to pay a price premium (Thomson et al., 2005).

### *Involvement*

Product involvement relates to the interest and emotional engagement evoked by a product category for a particular individual (Bloch, 1982). Early attachment studies distinguished between emotional attachment and product involvement to further define attachment as a construct (Schultz et al., 1989; Thomson et al., 2005). Involvement differs from attachment as it is associated with only the present rather than containing ties to memories and future aspirations. Distinctions have been made between two types of product involvement, situational and enduring (Bloch, 1982). Situational involvement arises from circumstances leading to increased interest in a product category, such as a new parent looking to buy a pram. This increased concern with a product category is short term and rapidly decreases once the required product is obtained. Enduring involvement stems from the strength of a product's link to an individual's needs, values or self-identity (Bloch, 1982). This is seen in the strong ongoing interest certain people dedicate to product categories, such as wine connoisseurs, car enthusiasts, audiophiles or sneaker collectors. The long-term meaning that an individual attributes to a product category is likely to contribute to feelings of attachment to a specific product within the respective category.

### *Materialism*

Materialism is defined as the *"importance a consumer attaches to worldly possessions"* (Belk, 1984, p. 291). This notion of importance shares a likeness with attachment, however it does not reflect the processes of self-extension inherent to experiences of attachment (Ball & Tasaki, 1992). The concept of materialism addresses the importance of possessions in general terms, however product attachment is usually concerned with specific objects. The importance or lack of importance an individual prescribes to possessions in general does not provide an indication of whether or not they are likely to become attached to a specific product (Ball & Tasaki, 1992; Wallendorf & Arnould, 1988). Consumers that are non-materialistic and assign little importance to possessions in general may still own several products to which they are strongly attached.

### *Attitudes*

Attitudes have been defined as *summary evaluations* of objects that are both analytic and affective in nature (Fazio, 2007). This relates to the ways in which an individual evaluates an object based on an appraisal of its attributes, the emotional reactions it evokes and their own past behaviour and experiences with the object or similar objects. Unlike attachment, favourable attitudes do not necessarily reflect the significance of a possession or involve ties to a person's sense of self (Thomson et al., 2005). Attitudes may play a role in the development of attachments as they influence the likelihood of an object remaining actively present in the lives of their owner. If an object evokes unfavourable attitudes, it may be thrown away or used less frequently. Attachments often develop over time through recurring interactions with the user (Kleine & Baker, 2004). An object that evokes favourable attitudes is more likely to be kept or used for a sufficiently long amount of time to allow for the development of attachment to occur.

### *Digital Possession Attachment*

Digital possessions are becoming increasingly prevalent in everyday life. They exist as replacements to existing material possessions such as e-books or digital photos and as entirely new forms of possession such as apps or online profiles. The construct of attachment has been explored in the context of digital possessions, with close resemblance to the characteristics of product attachment (Watkins & Molesworth, 2012). Digital possession attachments serve similar purposes to their material counterpart in extending

one's sense of self and characterising their owner's individuality or social connections (Kirk & Sellen, 2010). The transferable nature of digital possessions brings rise to difficulties in establishing a sense of singularity, uniqueness and ownership that is inherent to product attachment (Denegri-Knott et al., 2012; Odom et al., 2014). Cloud-based storage and streaming services further undermine their position as singular belongings as they blur the boundaries between attachment to a specific possession or any identical variant of the possession. For example, a digital photo taken at a friend's wedding may be a meaningful signifier of the experience, but the meaning equally applies to any accessible copy of the photo rather than a particular image file (Feinberg, 2013).

### *Collective Attachment*

Objects can evoke collective attachment when an emotional bond exists between an individual and a group of products (Slater, 2000). Each object is valued for its place within a collection that as a whole is considered meaningful, such as a record collection or photo album (Belk, 2013; Marshall, 2007). These collections often hold meaning that evolves over time as the collection itself changes. Collectively, they can be perceived to more deeply embody an individual's identity than any single product (Belk, 1988).

### *Psychological Ownership*

Psychological ownership has been defined as the *"state in which individuals feel as though the target of ownership (material or immaterial in nature) or a piece of it is <u>theirs</u>"* (Pierce, Kostova, & Dirks, 2001, p. 299). Several consumer behaviour researchers have framed psychological ownership as directly related to experiences of product attachment (Baxter, Aurisicchio, & Childs, 2015; Shu & Peck, 2011), arguing that through the development of possessory feelings, objects are imbued with greater value and become associated with the self. The construct of psychological ownership has received increased attention in recent years to address the blurred boundaries between ownership and access of digital possessions and how this may affect attachment experiences (Molesworth, Watkins, & Denegri-Knott, 2016; Watkins, Denegri-Knott, & Molesworth, 2016). Further studies have found physical objects to have a greater capacity than digital items to foster feelings of psychological ownership as their materiality suggests a greater degree of permanence and enables people to more easily establish a sense of control (Atasoy & Morewedge, 2017).

### 2.1.4 Evoking Attachment

People develop an attachment to their belongings for a range of reasons. They can be valued for the memories they bring to mind, enabling the achievement of goals, the enjoyment they provide through their use or the self-expressive opportunities they offer (Schifferstein & Zwartkruis-Pelgrim, 2008). These belongings can contain ties to significant people, places, experiences, values or beliefs that bring about a rich range of emotions (Mugge, Schifferstein, et al., 2005a). In their seminal study, Csikszentmihalyi and Rochberg-Halton (1981) interviewed 315 participants from 82 families about the things in their home that were considered *special*. A total of 1694 things were arranged into 37 *meaning categories*. These range from *object-based meanings* including memories brought to mind, significant associations to people, beliefs or values, experiences enabled by the object, favourable styling of the object, utilitarian value and *person-based meanings* with ties to the self, family, friends or associates. Schifferstein and Zwartkrius-Pelgrim (2008) identify memories and enjoyment as primary determinants for strong degrees of attachment. Products may also gain emotional significance for their involvement in a person's life story (Kleine et al., 1995). This includes products that reflect a person's autonomy as a unique individual, their affiliations to friends and family, fond recollections of the past or their hopes for the future. The role played by an individual's sense of self in their development of attachment to products is similarly emphasised by Govers and Mugge (2004) in which they found people were more likely to form attachment to products they perceived to possess personality characteristics similar to their own. In reference to long-lasting emotional feelings towards objects, Norman (2004) proposes that *"what matters is the history of interaction, the associations that people have with the objects, and the memories they evoke"* (p. 46). In these ways, attachment to things often develops from properties beyond their own materiality, extending to their links to aspects of the self or life narrative of an individual.

### 2.1.5 Outcomes of Product Attachment

The experience of product attachment can lead to an extensive range of desirable outcomes. This is evident in the wealth of research exploring the construct of product attachment across a range of fields including psychology, sociology, philosophy, material culture, consumer behaviour, human-computer interaction (HCI) and design (Belk,

1988; Csikszentmihalyi & Rochberg-Halton, 1981; Kirk & Sellen, 2010; Kleine & Baker, 2004; Miller, 1987; Mugge, 2007; Page, 2014; Schultz et al., 1989; Verbeek, 2005). Motivations to explore product attachment vary across these fields. Attachments to products can empower individuals in developing and maintaining a coherent sense of self (Wallendorf & Arnould, 1988), provide self-expressive opportunities (Mugge, Schifferstein, et al., 2005a), increase enjoyment (Schifferstein et al., 2004) and care (Belk, 1991) while interacting with a product, extend the product's lifespan (Chapman, 2009) and increase brand loyalty (Reed et al., 2012). While these outcomes are overwhelmingly beneficial, there is also the potential for negative outcomes to result from product attachment. Compulsive hoarding, the excessive acquisition and inability to throw away large quantities of objects, is a symptom of individuals who too easily develop attachments to objects (Grisham et al., 2009). Speaking more generally, the investment of personal meaning into objects can have negative consequences when faced with unexpected misfortune. The involuntary loss of a meaningful possession can result in a process of grief similar to that experienced from the death of a loved one (Belk, 1988). This can be prompted systematically, through admission to an institution that severely restricts access to personal possessions (e.g. psychiatric hospitals, aged care homes, prisons, military training camps or boarding schools) or through being a victim of theft or natural disasters. These instances of involuntary loss of a possession can also bring about a diminished sense of identity and feelings of a loss of uniqueness (Belk, 1988; Snyder & Fromkin, 1980). These outcomes, both positive and negative, convey the deep significance that products can hold in people's lives, exhibited through the experience of attachment.

While many of the outcomes listed above may occur in several types of attachment, researchers focusing on product attachment specifically highlight its unique potential for extending a product's lifespan. This outcome is particularly desirable from a sustainability standpoint as many products are thrown away when they are no longer wanted rather than when they break down (van Nes, 2003). Chapman (2009) explores the notion of emotional durability, which denotes the robustness of a product to remain wanted and desirable to the user in an emotional sense. This idea is extended when considering the *irreplaceability* of a possession, defined as a possession that *"a consumer resists replacing, even with an exact replica, because the consumer feels that the replica cannot sustain the same meaning as the original*" (Grayson & Shulman, 2000, p. 17). To be considered

irreplaceable, the meaning of a product and the product itself must be inseparable, otherwise the product is susceptible to being replaced by another that conveys the same meaning (Mugge et al., 2008). While product attachment may often lead to a possession being considered irreplaceable, these constructs can occur independently from one another (Grayson & Shulman, 2000). For example, a unique woodworking tool may not be meaningful but may be irreplaceable because of its rarity or a pair of headphones may be meaningful, but easily replaced by another pair of the same model of headphones.

## 2.2 Objects and Identity

Certain material possessions are kept and cared for long after their utilitarian value has passed. These, among other possessions, represent things we deem important in our lives or things we are reluctant to give up or replace. Feelings of significance are signs that we are strongly attached to these possessions. This attachment can be the result of years of shared experiences, accumulating a wealth of history with the owner. In this section, we address the question: why do we as humans become attached to certain objects? In the previous section, we provided an overview of the reported determinants for evoking attachment to an object. We now aim to address the underlying reasons for why these determinants are considered meaningful for users. In doing so, we establish a basis for how products become meaningful to guide the development of appropriate means of promoting product attachment within the design process.

### 2.2.1 Objects as a Source of Meaning

There is general agreement in literature that people develop an attachment to a belonging for its role in the construction, maintenance or development of an aspect of their self-identity (Ball & Tasaki, 1992; Belk, 1988; Csikszentmihalyi & Rochberg-Halton, 1981; Schultz et al., 1989). The incorporation of a possession within an individual's sense of self often transpires through its links to their past, present or anticipated future (Schultz et al., 1989). Meaningful products are used to characterise and communicate who we were, who we are and who we wish to become. The role of objects in the development of self-identity occurs throughout all stages of life (Myers, 1985). Psychologists have observed the relationships that infants develop with a certain doll or blanket as one of the first

instances of product attachment. These possessions are seen to be soothing as they augment the necessary calm and comfort provided by a parent. Through use of the object, an infant develops the ability to soothe themselves, growing beyond the need for an external soother (Tolpin, 1971). This process of self-development through engagement with objects is argued to be an ongoing process that continues throughout our entire lives as we continually expand and refine our sense of self (Myers, 1985). Kleine, Kleine and Allen (1995) propose two conventional themes that characterise the development of the self. The first of these themes suggests people are motivated to *"establish and maintain a personal and unique identity, distinct from that of others"* and to conversely *"maintain interpersonal connections that also define the self"* (pp. 328). Possessions reflect internal motivations for autonomy by providing evidence of individual accomplishments, such as a trophy, while motivations for affiliation are reflected by possessions that emphasise connection with others, such as a family photo album. The second theme suggests people must manage both change and stability in the development of their sense of self. This is reflected by advancements in identity theory that have led to the structuring of a person's sense of self as a *life narrative* (McAdams, 1985) in which moments from our past, present and anticipated future are connected to construct a coherent life story that reflects who we are as a person. Possessions reflect identity stability by demonstrating the continuation of a desirable past self, such as a teddy bear that connects someone with their fond childhood memories. Identity change can be reflected by possessions that help us disconnect from an aspect of our past self that is no longer desired or by signalling the development of a desired future self, for example a business suit that disconnects us from adolescence and reinforces an emerging professional identity.

### 2.2.2 Facets of the Self

Products can be meaningful for a range of reasons as we ourselves find meaning in a range of different ways. These meanings stem from various facets of our identity that reflect the different roles we play within our day-to-day lives. Each individual person is multi-dimensional, engaging in a range of roles such as being a loving mother, a hardworking lawyer, a mischievous sister and a thoughtful friend. Our behaviour, attitudes and values can vary depending on the role we are engaging in. This diversity within our sense of self is reflected by the diversity of things that bring meaning to our lives.

As a person's *self-identity* is multi-dimensional and ever-changing, efforts have been made to bring structure to the study of its development by categorising its elements. Several studies have addressed self-identity through its division into multiple identity facets (Csikszentmihalyi & Rochberg-Halton, 1981; Gubrium & Holstein, 2000; Tracy & Trethewey, 2005). Gubrium and Holstein (2000) discuss the *personal self*, determined by individual characteristics, and *social self*, determined by memberships in various social groups or categories, as interrelated but distinct identities of an individual that each informs the other. More recently, the idea of an *organisational self*, determined by an individual's place within a working environment, has been explored (Tian & Belk, 2005; Tracy & Trethewey, 2005). This *organisational self* is again interrelated to other facets of one's identity, influencing their personal and social identities to align with the characteristics of their profession (e.g. nurses identifying themselves with caring for others). Tian and Belk (2005) discuss the ways in which individuals use possessions to aid in switching between conflicting facets of the self; *self-as-worker* and *self-as-family-member*.

This stream of research that categorises aspects of identity by their origins in a personal, social or organisational sphere is but one of several streams within identity literature. Sirgy (1982) reviewed existing self-concept theories, pointing to a number of variations of self-concept categorisation including the "*real self*", *"actual self"*, *"basic self"*, *"extant self"*, *"ideal self"*, *"ideal social self"* or simply *"self"* (pp. 288). Greenwald (1988) proposed four facets of the self—the *"diffuse self"*, *"public self"*, *"private self"* and *"collective self"* (pp. 39). This inconsistency in phrasing used across self-concept theories has led some researchers to avoid using these types of categorisation entirely. Kleine, Kleine, and Kernan (1993) frame identities by the role undertaken by the individual, for example an *athlete*, *mother* or *gardener* identity. In their extensive review of identity-based consumer behaviour literature, Reed et al. (2012) similarly frame a person's self-conception as being made up of a number of identities that create a consistent narrative with each identity forming a mental image of what it means to be or not be that kind of person. Each unique identity then has a number of associations tied to it including behaviour, personality, values, places or things. These identity associations can either overlap or conflict with one another, for example being *aggressive* may be associated with one's professional identity as a stock trader and at the same time their identity as a football player.

### 2.2.3 Object-Identity Associations

Objects can assist in reaffirming someone's self-conception by providing evidence of their closeness to their own mental image of an identity. For example, a surf board can reaffirm a person's perception of themselves as a laid-back beachgoer. In this way, objects become associated with an identity and all that is involved with that particular identity. These identity-based associations that are assigned to objects can greatly influence their significance to the owner, becoming an extension of themselves.

In their extensive review of identity literature, Reed et al. (2012) argue that one's sense of self is made up of a number of identities, each with their own bundle of associations that define what it means to be or not be that type of person. These identities and their respective characteristics influence the likelihood of the associations an individual assigns to a particular product to be considered meaningful (Fazio, 2007). For example, a car enthusiast will more readily develop meaningful associations to a new car model than someone with little interest in cars. Possessions can also hold associations to multiple identities to varying degrees (Deaux, Reid, Mizrahi, & Ethier, 1995). This can be seen with a bicycle being associated with both personal fitness and membership within a local cycling club. In this way, objects can develop layers of meaning for their owner with ties to several emotionally significant aspects of their self-identity (Orth & van den Hoven, 2016).

Discussion in product attachment literature often refers to the *associations* that people assign to a possession. An object can hold meaning for its ties to significant memories, experiences, people, places or values. In their study of meaningful product relationships, Battarbee and Mattelmäki (2004) propose meaningful associations as one of three overarching categories for meaningful products alongside meaningful tools and living objects. Mugge, Schoormans and Schifferstein (2008) suggest four possible determinants of product attachment: pleasure, self-expression, group affiliation and memories, of which all but pleasure are associative in nature.

The associations that people assign to their things can come about in several ways (Kujala & Nurkka, 2012). They can arise from the history of ownership and usage of a possession, perceptions of its materiality such as form, colour, texture, size and smell or from beliefs held by the individual about the kinds of people who would own or use the product (Allen, 2002). The nature of these associations can vary from abstract to concrete,

fitting within a spectrum from indistinct values or feelings to specific memories. The resulting image that comes to mind in regard to an object is often complex and obscure as it encompasses associations from all aspects of the product experience.

Links between a product and an individual's sense of self can act as a primary reason for the significance ascribed to the product. The ways in which a person infers associations as they perceive a product provides designers with opportunities to promote the formation of meaningful human-object relationships through careful consideration of various design elements.

## 2.3 Meaningful Objects in the Digital Age

Technological advancements have rapidly created opportunities for designers to integrate digital functions into physical products. These products have become central to our lives and continue to expand forms of human-object interaction and activity. As more aspects of our lives move towards the digital realm, the field of product design is becoming increasingly integrated with interaction design (Vallgårda & Redström, 2007). The ways in which we interact with the digital functionality of a product reshapes the design of the product itself. Changes to the ways in which we engage with products similarly influences the connections we develop with these products. In recent years, the HCI community has sought to more deeply understand the relationships people develop with their technological devices, including the digital possessions stored or accessed from within. In many cases this work is done in a similar light to those looking at meaningful material possessions, with several directly comparing the influence of the object form on the formation of emotional significance (Golsteijn et al., 2012; Petrelli & Whittaker, 2010). The findings of these studies suggest that people often do not value their digital or physical-digital possessions as highly as their physical possessions (Golsteijn et al., 2012; Odom & Pierce, 2009; Odom et al., 2014; Petrelli & Whittaker, 2010). The role of object form on the development of emotional attachment to a possession has since become a key area of exploration in HCI research. In this section, we aim to outline the factors related to the diminishment of product attachment experienced, in contrast to non-digital products, within the growing sector of technological products.

### 2.3.1 Attachment to Digital Items

Digital items such as photos, songs, emails and apps are often valued in similar ways to their material counterpart as they allow us to express individuality (Bryant & Akerman, 2009), reflect our social ties (Martin, 2008), connect us to our past (Kirk & Sellen, 2010) and remind us of loved ones (Watkins & Molesworth, 2012). Much like material possessions, digital items can be highly valued for their role in self-extension processes (Belk, 2013). While the value these possessions provide may be similar in nature, there are distinct differences in the ways we perceive our physical and digital possessions that ultimately influences the value they attain. As outlined above, several studies have found that people are less likely to form an attachment to digital possessions than they are with their physical possessions. Findings suggest possible causes for this to include difficulties faced in presenting, displaying and re-visiting digital possessions due to their immaterial nature (Brown & Sellen, 2006; Petrelli & Whittaker, 2010) as well as complex issues relating to ownership, singularity, uniqueness and control (Cushing, 2013; Denegri-Knott et al., 2012; Odom et al., 2014). Others have argued that the barriers to value formation in digital possessions are caused by current technological limitations rather than their immaterial nature (Watkins & Molesworth, 2012). Many of these issues relate to the blurred nature of what constitutes a digital possession. Cloud-based storage and online streaming services dissolve the boundaries between ownership and access of digital media (Belk, 2013; Feinberg, 2013). In regards to digital possessions, Feinberg (2013) poses the question *"at what level of abstraction does attachment lie?"* (p. 7). She refers to the concept of the *intellectual work* using the example of Shakespeare's *Hamlet*, a play that exists in many varying editions and forms but in all cases, is still seen as one piece of work—*Hamlet*. This line of thought similarly applies to digital items such as songs, photos, video games, apps, programs and e-books in which meaning may be assigned to the *work* or a specific manifestation of it such as an MP3 file or CD. Further complications arise when these digital items are seen collectively as one. Much like the thousands of components that make up a single car, digital items often blur boundaries between individual and collective value (Belk, 2013; Feinberg, Geisler, Whitworth, & Clark, 2012; Marshall, 2007). A social media app may be viewed as a collection of photos and messages or as a single piece of software. Marshall (2007) proposes that a digital photo is characterised as more than just the image itself but also its membership within a

set of photos taken at the same event. These digital items may be valued not as individual things, but for their place within a collection that as a whole is considered meaningful such as songs found within a personal music library or a collection of photos from a family vacation (Belk, 2013).

### 2.3.2 Attachment to Physical-Digital Products

The question of abstraction and attachment has been well considered in physical objects with conceptual boundaries established between attachment to a specific thing versus a product category (Costley, 1988), brand (Fournier, 1998) or possessions in general (Belk, 1988). As discussed above, strides have been made in addressing this matter in the context of digital possessions despite the complexity in doing so. Similar issues are faced in discovering where attachment lies in physical-digital products as they fit within the context of physical objects yet also contain digital media within them that can also be considered meaningful. Early work investigating people's attachment to their mobile phones suggested it was not the device itself but rather the relationships with others it embodied that gave it meaning (Vincent, 2006). More recent work looking at mobile phones argues that attachment to the device and the brand or software system overlap and therefore result in attachment that may be transferred to a newer version of the same device (Meschtscherjakov et al., 2014).

Philosophical critique of technological products argue that the concealment of a device's functionality leads to a diminished sense of worth for the device itself (Borgmann, 1984; Verbeek, 2005). This concealment of electrical components and processes causes a conceptual distinction in the mind of the user between the device and its digital output, for example, an mp3 player and the music it produces, or a camera and the digital photos captured. A number of studies have since found distinction between people's attachment to a *thing* itself versus attachment to what it *provides* (Golsteijn et al., 2012; Kirk & Sellen, 2010; Odom & Pierce, 2009). Their findings suggest that people often express strong attachment to what a physical-digital product provides, but rarely to the device itself, instead perceiving them to be highly useful but replaceable tools. Kirk & Sellen (2010) found that VHS or cassette tapes held no sentimental value as physical objects yet their contents were considered highly significant. These studies are limited in their ability to

provide further insight into the effect of this conceptual distinction on meaning-making processes.

Despite their significant role in people's lives, physical-digital products are often replaced far before their functional lifetime expires (Huang & Truong, 2008). This rate of consumption referred by Huang and Truong (2008) as a *"disposable technology paradigm"* (p. 323) amplifies a number of sustainability issues such as resource scarcity and e-waste management (Deng, Giesy, So, & Zheng, 2017). From a sustainability perspective, promoting emotional user-object relationships through design has been considered as a viable strategy to address issues with the rate of product consumption (Gegenbauer & Huang, 2012; Huang & Truong, 2008).

Technological devices are often used in conjunction with one another, for example someone might check their emails on their laptop, tablet or phone depending on their location. Alternately, pictures taken with a digital camera might be edited or stored on a desktop computer. This has led several HCI researchers to examine the relationships between devices to broaden our understanding of the meanings people assign to their physical-digital possessions and better understand the ways in which people incorporate new technologies into their lives (Bødker & Klokmose, 2012; Brodersen, Bødker, & Klokmose, 2007; Jung & Stolterman, 2012). While consideration of the 'ecologies' of artefacts that users engage with can provide deeper insights into user-object relationships, it fails to address the parallel need for more sustainable product consumption practices. There is a need to create long lasting physical-digital products that develop unique personal meanings imbued within their materiality. For this reason, we focus our attention on exploring ways in which designers can create more meaningful and singular physical-digital products.

### 2.3.3 Meaningful Integration of the Physical and Digital

The personal meaning of a possession may be assigned at a level of abstraction beyond the singular material object that characterises product attachment as a construct. This issue is heightened in the context of physical-digital products as the abstraction of meaning can occur at both the material and digital level. Many researchers have explored ways to more closely integrate the physical and digital components of a technological product (Golsteijn, van den Hoven, Frohlich, & Sellen, 2014; Kirk & Sellen, 2010; van

den Hoven & Eggen, 2004; West, Quigley, & Kay, 2007). The intended benefits of integrating physical and digital components include improvements to the usability or usefulness of a system (Fitzmaurice, 1996; West et al., 2007) and to better support everyday life practices, including recollecting personal memories (van den Hoven, 2004) and engaging in self-expressive activities (Golsteijn et al., 2014). Tangible and embodied interaction has become an established field of research and design practice for researchers and makers exploring ways to more closely integrate the physical and digital components of technological products (Dourish, 2004; Hornecker, 2015; van den Hoven et al., 2007). Tangible and embodied interaction intends to take advantage of natural physical affordances to create a seamless interaction between the user and the digital information through their engagement with the physical device. This includes *tangible manipulation* that allows the user to grasp and control physical objects and surfaces to engage with related digital media or functionality (Hornecker & Buur, 2006).

From a product attachment perspective, this seamless integration of physical and digital components holds merit in ensuring the meaning assigned to a possession is associated with its specific materiality (Verbeek, 2005). Physical objects can be associated with specific digital information or functionality in a number of ways (Holmquist, Redström, & Ljungstrand, 1999). The object and digital information can possess shared representational properties that arise through usage scenarios or shared involvement in past experiences such as a physical souvenir and digital photos that were both acquired during an overseas holiday. In the context of personal associations, the properties shared by both the physical object and digital information are not necessarily direct, literal commonalities. They can also share properties by both containing associations to a third entity, a source of personal meaning. This is seen in the ties shared in the prior example of a physical souvenir and digital photos both being associated with an overseas holiday. These do not relate to each other directly but possess a *shared meaning* that facilitates their integration in the mental model of the user (see Figure 5). In this example, the personal associations directly relate to where and when the possessions were acquired (during an overseas holiday) and are therefore perceived by the owner to be inherent to the possession itself. While personal associations often develop from the inherent proximity of the object to the source of meaning, such as their role in past events as outlined by Van den Hoven and Eggen (2004), objects can also acquire personal associations through the imagery

evoked by their physical properties (Orth, Thurgood, & van den Hoven, 2018). Inherent associations relate to the thoughts that are brought to mind by a possession in the moment it is acquired, regardless of whether it is bought, created or received as a gift. This includes the evaluative assessment of the object or item in relation to its material and aesthetic properties, the product experience, the way in which it was acquired and beliefs of the kind of person who would use or own such an object or item. Associations can also be learned over time through engagement with an object or item. These associations can be generic (e.g. learning the corresponding functions of the button controls on a digital camera) or personal (e.g. the memories that develop over time with a car used for family road trips) in nature. As discussed in the previous section of this chapter, objects acquire meaning through their associations to aspects of the user's self-identity. These associations are inherently personal rather than generic in nature.

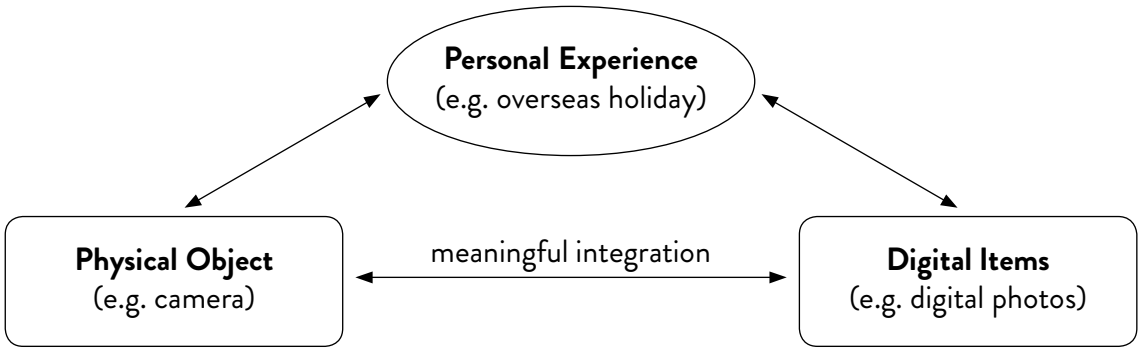


**Figure 5. A model of shared meaning between the physical and digital.**

The physical and digital elements of a product can be meaningfully integrated by creating associations with a homogeneous meaning. Links between a physical object and digital information may also be described as either *fixed* or *flexible* (van den Hoven & Eggen, 2004). *Fixed* associations do not change over time and often relate to tangible interaction objects that are linked with only a single digital function or item, such as a musical birthday card that will always play the same song when opened. This direction has less relevance in current practices involving digital information as people often engage with their digital possessions collectively (Belk, 2013) or across several devices (Jung, Stolterman, Ryan, Thompson, & Siegel, 2008). *Flexible* associations can change over time and relate to physical objects with links to more than one piece of digital information, often referred to as *overloading* (Holmquist et al., 1999). A USB flash drive can contain associations to several files stored within it. Files can be added, deleted or manipulated,

causing these associations to change over time. If the association of digital information with a physical object is unconstrained, such as the example of a USB flash drive, then the physical and digital do not share any representational properties that enhance their perceived integration.

Returning to the objectives of this thesis, the continual change in digital information that is associated with a physical device presents a key challenge to creating meaningful physical-digital products. Physical devices are singular and static, yet their digital contents are often dynamic and ever-changing. How can these contradictory properties of continuity and change be managed to allow for meaningful integration that unifies the physical and digital components of a physical-digital product? This issue of continuity versus change relates directly to sustainability concerns for current rates of product consumption. Physical devices are at risk of becoming outdated or detached from the evolving personal meanings ascribed to a technological product as they are unable to maintain shared properties that link them to their evolving digital contents.

It is possible however to link a physical object and variable digital information through forming shared meaning that is both continuous and evolving over time. This can be done by constraining the tangible object and digital information to evoke associations that are specific enough to hold personal meaning for the user, yet abstract enough to evolve over time, thus aligning to developments of the user's self-identity (see Figure 6). For example, an individual may have a specific and unique mental model of *road trips*, yet this mental model will also continuously evolve over time as they continue to go on new road trips with different passengers, distances and destinations. How this *evolving* meaning might be associated with a static physical object and a correlating dynamic collection of digital information depends on the design of the physical-digital product.

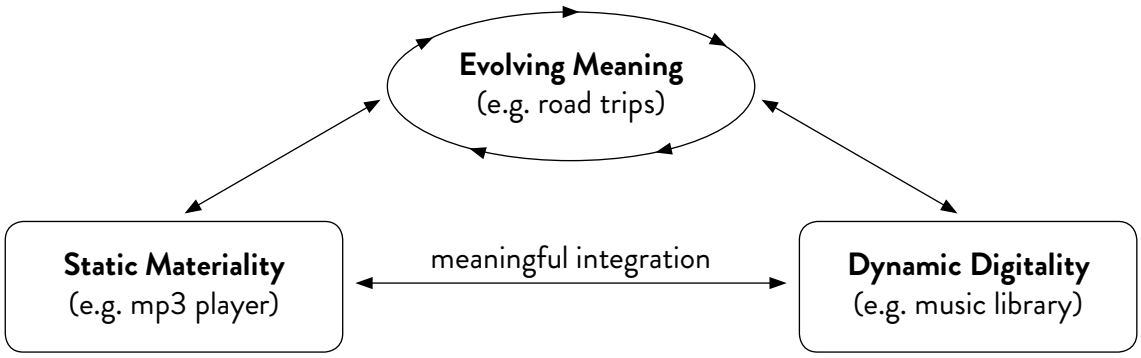


**Figure 6. A model of evolving meaning that integrates static materiality and dynamic digitality.**

The intended outcome of such a product might best be illustrated by the unified and evolving meaning of a family photo album. While this example is a system of purely physical products, the relationship between a leather-bound photo album as a *container* and the photos kept inside as *contents* shares parallels to many physical-digital product systems. The *content* stored within the photo album evolves over time as additional photos are added, capturing new significant family moments. Old or less meaningful photos may be removed over time to provide additional space. The physical *container* itself remains static, yet its association to meaningful family moments evolves in parallel with each change to the contents. Both the album itself and the ever-changing collection of photos are associated with *family*. The specificity of the album as a *family* photo album may aid in this meaningful integration between container and contents. In contrast to this, the collection of digital photos stored within a camera is often much larger and more varied (Van House, 2011). The content of the photos may vary to include family occasions, landscapes, leisure activities, sporting events and everyday moments. The significance of these photos may also range from meaningful to meaningless, further blurring the clarity of association between the physical-digital product as a whole and a particular source of meaning.

These changes to the ways in which people engage with their possessions influence the assignment of meaning that is inherent to the construct of product attachment. While physical-digital products contain functionality that continues to expand the capabilities of their users, they also signify a shift in the nature of human-object relationships. The practice of design holds strong potential to influence these relationships to promote the continuation and prevalence of product attachment.

## 2.4 Designing for Product Attachment

In the previous sections of this chapter, we have outlined the nature of product attachment, why it occurs, and the positive outcomes it produces. Most significantly, the experience of product attachment empowers users to develop and maintain a sense of self, provides self-expressive opportunities, and promotes more sustainable consumer behaviour through extending product lifetime and care. These benefits have led many design researchers to search for ways in which designers may be able to promote the formation of attachment to the products they create.

While substantial contributions have been made to advance our understanding of why and how people develop an attachment to their things, little progress has been made towards applying this theory to design practice. Efforts to bridge this gap between theory and practice have primarily been made in one of two ways. Firstly, by evaluating existing user-product relationships to formulate design strategies for promoting attachment (see Golsteijn et al., 2012; Mugge, Schoormans, & Schifferstein, 2009; Niinimäki & Koskinen, 2011; Odom et al., 2009; Schifferstein & Zwartkruis-Pelgrim, 2008). Secondly, through the process of creating product concepts or artefacts seeking to promote attachment among users and evaluating their success in doing so (see Desmet et al., 2001; Gegenbauer & Huang, 2012; Lacey, 2009; Van Krieken, Desmet, Aliakseyeu, & Mason, 2012; Zimmerman, 2009). In this section, we provide an overview of the design strategies and guidelines devised to aid designers to promote the formation of product attachment and the practice-based exploration and evaluation of product concepts or prototypes.

While the concluding outcome of this thesis is to provide insights into the design of meaningful physical-digital products, it is worth first focusing attention on the ways in which designers can promote attachment to non-digital objects. Many of the existing design strategies and prototypes developed to explore the potential for designing product attachment focus their attention on physical products with relatively simple functionality. Even in the simplest products, the experience of attachment remains difficult to measure or evaluate due to its complex and highly personal nature. Exploration of the design of meaningful physical objects can provide a foundation to build upon and later introduce the layered complexity of our relationship with physical-digital things.

### 2.4.1 Design Strategies

In the study of physical products, a number of possible determinants for product attachment have been suggested with recurring themes related to memories, enjoyment, self-image, group affiliations, utility and appearance (Csikszentmihalyi & Rochberg-Halton, 1981; Mugge, Schifferstein, et al., 2005a; Schifferstein & Zwartkruis-Pelgrim, 2008). From these determinants, a range of design strategies for facilitating attachment have been proposed. Schifferstein and Zwartkruis-Pelgrim (2008) suggest that designers should aim to create products that evoke enjoyment or facilitate personal associations. Mugge, Schoormans, and Schifferstein (2005) propose two strategies for designers: stimulating social contact and incorporating odours as ways of encouraging associations with others and product-related memories. Further evaluative studies have since highlighted memories or personal associations as a primary determinant for strong degrees of attachment (Niinimäki & Koskinen, 2011; Page, 2014).

Studies investigating the longevity of physical-digital products advocate for more meaningful integration of the physical and digital components of these products to strengthen their emotional value over time (Golsteijn et al., 2012; Odom & Pierce, 2009). This relates to Vallgårda and Redström's (2007) notion of *computational composites* that suggests digital information should be treated as a material with unique properties that can be combined with other physical materials to create new and innovative forms. Odom and Pierce (2009) also propose that designers should aim to create associations between an object and stories that are personal and meaningful to the owner. In their in-depth study of deeply loved objects, Jung et al. (2011) suggest interaction designers should aim to create a sense of rarity within the device or digital information they are designing. This can be achieved by inviting users to manipulate the device or item in a way that enhances its unique qualities, allowing it to be perceived as rare.

### 2.4.2 Design Examples

While design strategies developed in research provide promising avenues for designers seeking to promote attachment in their practice, the effectiveness of these strategies often remain unverified. For this reason, many design researchers endeavour to bridge the gap between theory and practice by conceptualising, creating and evaluating novel products to determine the value of theorised strategies for promoting product attachment. The

goals of these studies often vary, emphasising outcomes related to sustainable consumption and product longevity (Gegenbauer & Huang, 2012), engagement (Lacey, 2009), or expression and development of the self (Zimmerman, 2009).

### *Physical Designs*

Several case studies have detailed the design of novel physical objects with an emphasis on emotional significance. Many of these designs seek to establish emotional significance with users through engaging interactions. In her paper, Lacey (2009) presents a range of emotive ceramic cup and saucer designs that play on the ideas of engagement and empathy within the user experience. After evaluating these designs with users, she emphasises the impact of individual preferences on the attachment experience, proposing that designers should allow consumers choice within a set of objects to increase the likelihood of attachment to mass produced products. In their efforts to add emotional value to mobile phones through design decisions, Desmet et al. (2001) similarly conclude that no single product will have emotional value for all intended users, suggesting the need for custom design practice. Van Krieken et al. (2012) further explore the use of engaging interactions through developing and evaluating a *sneaky kettle* that reveals signs of animacy and personality by rotating when nobody is looking.

### *Physical-Digital Designs*

Several researchers have used insights from emotional attachment theory to inform the construction or conceptualisation of novel physical-digital designs. Zimmerman (2009) presents a range of designs resulting from a process of *designing for the self* that intends to aid people in moving closer to their ideal-self in a specific role. This includes the *Reverse Alarm Clock* that helps keep children from waking their parents before it is time to get up and is intended to foster better parent-child relationships. Gegenbauer and Huang (2012) use categories of attachment to generate a range of design concepts related to modification, personalisation and personal histories. Concepts include transforming an old tablet to be used as a digital photo frame and using materials that age gracefully such as leather for the exterior housing of a laptop. Golsteijn et al. (2014) created a kit that allows people to engage in *hybrid crafting* to create objects that integrate physical form with digital media. The *Materialise* kit contains physical, Lego-like building blocks with various interchangeable digital components such as a touch screen display or speaker that

can be configured and assembled into novel forms. These examples provide inspiration for designers seeking to promote emotional attachment towards physical-digital products, yet still leave room for further exploration of how designers can meaningfully integrate tangible and intangible form.

### *Evaluating Design Artefacts and Strategies*

Many of these studies exploring the practice of applying attachment theory through the design of novel artefacts are limited in their ability to sufficiently evaluate the artefacts and measure their intended outcomes. While tools have been developed to evaluate people's emotional reactions to products (e.g., Desmet, 2003b; Kujala & Nurkka, 2012), evaluating the effectiveness of designed artefacts in fulfilling goals related to the formation of attachment remains a difficult challenge for design researchers. Several design strategies emphasise long-term meaning or increasing the likelihood of meaning to develop over time, rather than immediate emotional responses. Evaluation of these strategies requires a longitudinal approach such as the methodology adopted by Mugge, Schifferstein and Schoormans (2005a) in their study of new university student's development of attachment to a backpack over a five month period. Limitations still remain for any evaluation or measurement of product attachment as the establishment of an emotional bond can take many years (Russo, 2010; Schifferstein & Zwartkruis-Pelgrim, 2008).

## 2.4.3 Meaningful Associations

With the exception of Zimmerman (2009), studies involving the creation of product concepts or artefacts intended to promote attachment among users largely omit the wealth of literature stemming from material culture, sociology and consumer research that emphasise the role of self-identity in meaningful user-object relationships. This is surprising as studies that evaluate user relationships with existing possessions often point towards meaningful memories and personal associations as key determinants for strong degrees of attachment (Csikszentmihalyi & Rochberg-Halton, 1981; Kujala & Nurkka, 2012; Page, 2014; Schifferstein & Zwartkruis-Pelgrim, 2008). As discussed in the previous section of this chapter, objects often acquire meaning from their associations to personally significant aspects of the user's self-identity. This disconnect in the prevalence of memories and personal associations between studies that *observe* product attachment

and studies that aim to *create* product attachment is not without reason. Utilising meaningful memories and associations within a design process has been acknowledged as a promising yet difficult and restrictive task (Niinimäki & Koskinen, 2011; Page, 2014). Designers cannot design an emotional experience, they can only design *for* an emotional experience as emotions are ephemeral and dependant on context (Hassenzahl, 2004). Designers are therefore limited to create possibilities instead of certainties in any attempts to utilise personally meaningful memories and associations within a design process. Memories and personal associations are unique to the individual and therefore would require a personalised design practice for application, however this limitation may also be inherent to the construct of product attachment as a unique experience (Niinimäki & Koskinen, 2011).

Associations that develop from an object's material properties are heavily considered in current design practice for a variety of purposes. Norman (1988) addresses this issue at length from the perspective of usability in his book *The Design of Everyday Things*, using the example of door designs that provide signals to the user on whether they should be pushed or pulled to open. Crilly, Moultrie and Clarkson (2009) formulate eight types of associative responses that industrial designers intend to elicit through their designs; attention, recognition, attraction, comprehension, attribution, identification, emotion and action. Hekkert and Cila (2015) discuss designers' usage of *product metaphors* in which a design *"intentionally references the physical properties of another entity for specific, expressive purposes"* (p. 199). In creating these product metaphors, designers deliberately and carefully manipulate the physical properties of a product to assign values and meanings that fit their intentions.

The principle of an object's material properties being able to be manipulated by a designer in such a way as to elicit a desired associative response in the user provides a foundation on which to imbue personal meaning. Mental connections between a product and an individual's sense of self often acts as a primary reason for the product's significance. Eliciting an association that is perceived by the user to be personally meaningful is a particularly challenging design objective. The mental models that people develop for their past experiences, present beliefs, attitudes and values, and anticipated future are often deeply layered and changing over time (Demirbilek & Sener, 2003). Associative responses to a product are similarly layered and complex, as the semantic,

aesthetic and symbolic meanings ascribed to a product each influence perceptions of the others (Crilly et al., 2004).

An ideal example of designing meaningful associations beyond the focus of product attachment can be seen in the process and resulting artefact *Story Shell*, a bespoke digital memorial developed by Moncur et al. (2015) shown in Figure 7. Moncur et al. adopt a participatory design approach, working with a bereaved parent to develop a bespoke, tangible, digital memorial. The device contains audio recorded stories and internal decorations that represent elements of past personal experiences shared by the intended user and their lost loved one. Careful consideration is also given to the tactility of the device, the intimacy of interactions and the form directing attention inwards, inviting the user to reflect. The design of the device prompts meaningful associations between its materiality and past experiences that hold personal significance to the user.

**Figure 7. Story Shell, a bespoke digital memorial (Moncur et al., 2015).**

## 2.5 Conclusion

In this chapter, we provided an overview of the construct of product attachment, why it occurs, and what effects it has on human-object relationships. We established the position that product attachment is directly related to extension of the self. Products evoke feelings of attachment through their ability to characterise, maintain, communicate or develop an aspect of the user's self-identity. This process occurs through associating a particular object to a significant facet of one's sense of self.

In the latter half of this chapter, we referred to literature that provides initial explorations of the nature of product attachment experiences between people and their digital or physical-digital belongings. Several studies concluded that people are less likely to develop an attachment to their digital and physical-digital belongings, yet do not provide clear reasoning for why this is or how this issue might be addressed. Product attachment to both physical and digital belongings was then framed from the perspective of design and HCI research, considering how designers can promote the formation or development of attachment within their designs. Studies that examine the determinants of product attachment often point towards factors closely related to a sense of self, such as memories, group affiliation and self-expression (Mugge et al., 2008) yet many of the design strategies and examples put forward focus primarily on creating novel and engaging user interactions.

The proceeding chapters aim to empirically explore these gaps in existing literature to provide insights that advance our understanding of how designers can promote the development of product attachment within their practice. We first address ways in which design can better facilitate the relationship between physical objects and an individual's sense of self. We then address how this relationship differs with physical-digital objects. With consideration of these differences, we conclude by exploring ways in which design can better facilitate the relationship between physical-digital objects and an individual's sense of self.

# 3

# MEANINGFUL OBJECTS

In Chapter 2, product attachment was positioned to directly relate to self-extension processes. Consequently, it is worth exploring product attachment through the lens of self-identity theory constructs to explore ways in which design decisions may foster its development among users. This chapter investigates the relationship between self-identity and meaningful objects to reveal opportunities for design to facilitate aspects of this relationship. Probing activities and interviews were conducted with ten participants to discuss the roles of their everyday and meaningful possessions in constructing, developing and maintaining aspects of their sense of self. The study revealed several themes that collectively suggest meaningful objects often hold layered meaningful associations with the user's selfhood and life story. In many cases these associations stemmed from material, functional or contextual properties of the object that fit within the domain of design practices, suggesting an opportunity for designers to influence the personal value evoked by an object.

This chapter is based on:
Orth, D., & van den Hoven, E. (2016). "I wouldn't choose that key ring; it's not me": A design study of cherished possessions and the self. In *Proceedings of the 28th Australian Conference on Computer-Human Interaction* (pp. 316-325). New York, NY: ACM.

## 3.1 Introduction

We accumulate and discard countless possessions throughout our lives, however only a select few impart a profound lasting impression. These cherished possessions help us to continuously develop as a person and better understand our place in the world. This chapter explores the relationship between self-identity and product attachment, considering the role that each plays on the ongoing development of the other. We devised and then deployed a design study that explored the rationale behind people's attachment to certain possessions and the varying roles that these possessions play throughout the development of people's multi-faceted identities. A number of probing activities were conducted in parallel with semi-structured interviews to frame meaningful objects in relation to several self-identity theory constructs. In doing so, we aim to expand upon previous studies exploration of how the design of new products and systems can promote product attachment by focusing on self-identity and its notable role in the formation of meaningful human-object relationships.

Just like the seminal work by Csikszentmihalyi and Rochberg-Halton (1981), most studies have looked at meaningful possessions that are significant to an individual in the present (Golsteijn et al., 2012; Kleine et al., 1995; Schultz et al., 1989). In our work we adopt the approach of Myers (1985) to more deeply consider the role of meaningful possessions throughout the lives of individuals; encouraging retrospective and prospective thought on what was, what is and what may become a meaningful possession. We present a thematic analysis of our findings to highlight central themes to participants' reasoning for cherishment and the relevance of self-identity theory constructs in the development of design strategies or guidelines for promoting product attachment.

## 3.2 Method

As the topic of emotional significance in human-object relationships is interdisciplinary, the methods used to study this bond have ranged broadly from Q-Methodology (Kleine et al., 1995), questionnaires (Dyl & Wapner, 1996; Schifferstein & Zwartkruis-Pelgrim, 2008; Schultz et al., 1989; Weiss et al., 2009), interviews (Denegri-Knott et al., 2012; Dyl & Wapner, 1996; Kirk & Sellen, 2010; Lacey, 2009), focus groups (Golsteijn et al.,

2012; Wallendorf & Arnould, 1988) and non-verbal self-report instruments such as PrEmo (Desmet, 2003a). The intended outcomes of our research are primarily to inform design practice. We therefore adopt methodologies that are suitable for producing insights that are translatable and applicable to the processes of design practitioners. Mediating differences between scientific theory and design practice represents a central challenge to the work done by design researchers (Stolterman, 2008). Criticisms have been made for the translation of theory-based knowledge into design guidelines or analytic frameworks that have limited utility in practice (Rogers, 2004). Our methodological approach was inspired by the cultural probe method first introduced by Gaver et al. (1999), following its design-centric use of aesthetic and unconventional tools for gathering data about people's lives, values and thoughts. This led us to create two probing activities we refer to as *object interventions* and *identity timelines* that specifically target the phenomena we wish to address. Much like design probes (Mattelmäki, 2006), our probing methods were used primarily to facilitate informative dialogue with participants in the form of semi-structured interviews. We involved participants in the interpretation of study materials and in turn used these articulated reflections of participants to elaborate on the relationships between design, object and self-identity through analytic methods much like Crabtree et al. (2003). These probing methods aim to balance the theoretical understandings that informed their development alongside open-ended inquiries that echo the ill-constrained nature of creative practices.

### 3.2.1 Participants

A total of ten people participated in the study and were recruited from the broader social connections of the researchers. To give an indication of the variation of meaningful possessions across life stages, participants were selected from a broad age range between 18 and 66 years old, detailed in Table 1. Participants came from a diverse range of professions and had no prior knowledge of the study. As reward for their involvement, participants were able to keep any of the probe materials used throughout the study.

| Participant (Px) | Gender (F/M) | Age (yo) | Participant (Px) | Gender (F/M) | Age (yo) |
|---|---|---|---|---|---|
| P1 | Female | 53 | P6 | Male | 28 |
| P2 | Female | 52 | P7 | Female | 36 |
| P3 | Male | 55 | P8 | Female | 66 |
| P4 | Female | 35 | P9 | Female | 18 |
| P5 | Male | 24 | P10 | Male | 19 |

**Table 1. Participant number, gender and age.**

### 3.2.2 Procedure

In the following section we detail the probing activities and materials devised for the study.

#### *Object Interventions*

The first activity, described as *object interventions*, involved a range of five objects used in day-to-day activities (a mug, pen, tea towel, key ring and lamp) and five objects used for decoration or contemplation (a sculpture, photo frame, plant, visual art and plush toy) shown in Figure 8 that were presented to participants in their homes. Participants were asked to select three functioning objects and three decorative objects that fit within object categories that are used or seen in their normal routines. They were then asked to substitute their existing possessions from these categories with the objects presented (i.e. replace their own mug with the mug presented) for a period of two weeks. The objects that were replaced were stored away by the researchers and their replacements were placed in their vacant locations. At the end of the two-week period, participants were asked to rate each of their original possessions and the selected substitute possessions on a scale from *me–not me* and *strong emotional attachment–no emotional attachment*. It can be difficult for people to describe the idiosyncratic complexities of the attachment felt towards a possession (Richins, 1994). The purpose of this exercise was less about gathering accurate data on the relative significance of these items, but more-so to aid participants in expressing the ill-defined differences that influence their perceptions of functionally similar objects.


**Figure 8. From left to right, five active objects: mug, tea towel, key ring, pen, lamp and five contemplative objects: plant, photo frame, sculpture, visual art and plush toy.**

### *Identity Timelines*

The second part of the study involved three *identity timelines* (see Figure 9), each to be filled in by participants with their most cherished possessions from the day they were born to what they cherish now and to what they think they may cherish in the future. While the inclusion of retrospective and prospective thought on what was and what may become a meaningful possession cannot be deemed accurate measures of the significance of possessions during these alternate periods in time (McAdams, 2001), they may provide insight into people's current perceptions of both past and anticipated future selves (Kleine et al., 1995). This aligns with advancements in identity theory that have led to the structuring of a person's sense of self as a *life narrative* (McAdams, 1985) in which moments from our past, present and anticipated future are connected to construct a coherent narrative that reflects who we are as a person.

Using existing frameworks of identity facets (Gubrium & Holstein, 2000; Tian & Belk, 2005; Tracy & Trethewey, 2005), we categorised identity under three key areas; personal, social and organisational to allow participants to frame the value ascribed to meaningful possessions within their self-reported identity.

**Personal Identity**: A person's individual interests, values, behaviours and tastes.

**Social Identity**: A person's interpersonal relationships to another or group of others.

**Organisational Identity**: A person's values, personality, goals and behaviours within a working environment.

Brief descriptions of each identity category were accompanied by an image to evoke a richer, subjective interpretation of the task beyond the semantics of the wording used. A short list of example possessions was also provided to convey the breadth of items to consider. We wanted participants to think freely of items beyond their material objects such as digital objects (e.g. emails, a social media profile) and intangible items (e.g. a tattoo, bank account or award for excellence) that may still be considered significant to their identity. The identity timelines were left with participants to complete over a two-week period. At the end of this period, participants were given the opportunity to add, remove or relocate any possessions listed on the timelines before submitting their responses.

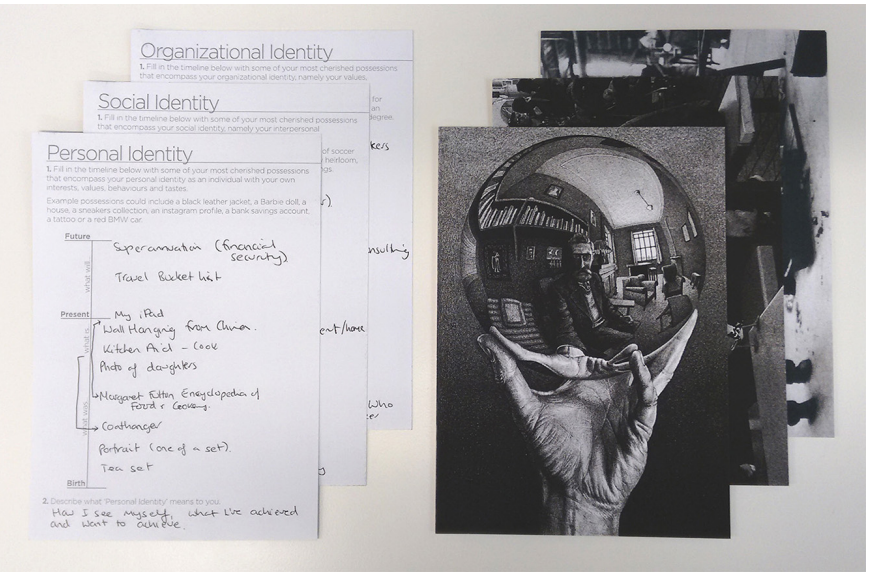


**Figure 9. *Identity timeline* cards front and back.**

### *Interviews*

At the end of the two-week study period, a concluding semi-structured interview was conducted with each participant to discuss and evaluate the ratings given to the original and substitute objects and the possessions listed on their identity timelines. As remuneration, participants were given the option to keep any of the everyday objects that they had adopted as part of the study.

## 3.2.3 Data Collection and Analysis

Collected data included completed *identity timelines* with written descriptions of each meaningful possession, photos of each participant's spatial ratings of the original and

substitute objects involved in the *object interventions* (see Figure 10) and audio recordings captured during the concluding interview sessions.

All interviews were transcribed and coded using the inductive thematic analysis procedure outlined by Braun and Clarke (2006). The data were thoughtfully read with segments considered meaningful to the research topic identified and then grouped in analytic categories. Interview content was coded using the set of themes and sub-themes created in the thematic analysis. A second coder was used to establish the coherence of the three key themes with a high level of interrater reliability ($\kappa = 0.9211$). Household objects included in the two-week *object interventions* activity were analysed from the spatial ratings provided by participants.

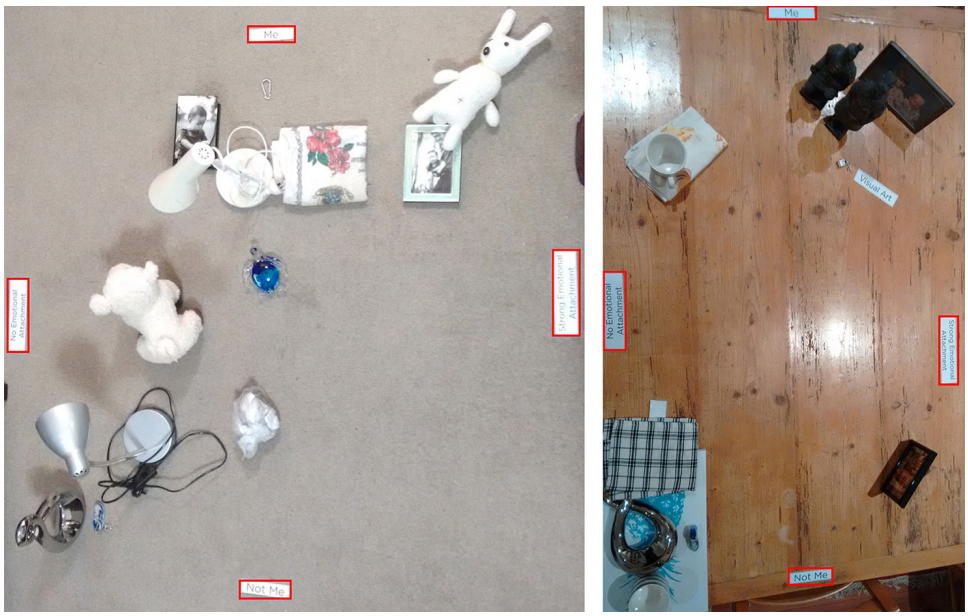


**Figure 10. Two participants' (P2 and P4) spatial ratings of objects from *no emotional attachment* (left label) to *strong emotional attachment* (right label) and *not me* (bottom label) to *me* (top label).**

## 3.3 Findings

In this section we present our findings from the design study conducted in the homes of ten participants. First, we present the results of the *identity timelines* in relation to the three pre-defined identity facets—personal, social and organisational—to reveal the varying reasons for cherishing possessions within these differing contexts. Second, we detail the findings of the *object interventions* including the object selection choices of

participants and the reasoning behind the comparative ratings given to original and substitute objects. Finally, we present our general findings through the three key themes created in our thematic analysis of the interviews discussing the experiences of participants with both prior mentioned activities.

### 3.3.1 Identity Timelines

The ten participants listed a total of 235 meaningful possessions within their *identity timelines*. Listed possessions included 181 physical objects (e.g. clothing, furniture, jewellery, vehicle, trophy, certificate), 25 digital objects (e.g. social media account, podcasts, email, digital photos) and 29 physical-digital objects (e.g. laptop, phone, camera, gaming console, tablet). Despite stimulus examples being provided of digital possessions, the large majority of possessions listed by participants were physical. This low representation of digital objects among possessions listed by participants as meaningful is consistent with similar studies (Golsteijn et al., 2012; Petrelli, Van den Hoven, & Whittaker, 2009; Petrelli & Whittaker, 2010). Physical, digital and physical-digital objects were fairly consistent in their representation among the three identity facets.

#### *Personal Identity*

Meaningful possessions listed under personal identity often contained vivid descriptions of the possessions themselves and the memories they bring to mind. For actively used possessions, meaning often stemmed from the possession's characteristics: *"I remember it because of the pleats [...] I was mesmerised by these pleats, I thought they were the hottest thing"* [P8, skirt] while other possessions were retrospectively valued for their association to positive past experiences: *"it's more a memento from my time in China. That's what's important"* [P1, wall hanging].

#### *Social Identity*

Possessions within the social identity category were often valued for their associations to others or a group of others: *"they remind me of all the snow trips I've been on with [dad and brother] […] it just reminded me of family winter holidays"* [P9, skis]. In other instances, possessions represented a sense of membership and belonging to a certain group: *"the shorts had this sort of trim down the side of them that none of the other crews were allowed to*

*have so that was significant and said you were a member of that particular crew"* [P3, rowing outfit].

### *Organisational Identity*

Possessions attributed to a participant's organisational identity were often associated to feelings of pride in a personal accomplishment. These possessions could be physical representations of the accomplishment: *"it looks nice. It's something to show off your hard work"* [P6, framed university degree] or simply the feat itself, devoid of physicality: *"that was a great personal achievement of mine, I think it's helped me have a foundation of certain values and behaviours"* [P7, university degree].

### *Division of Identity Facets*

Many participants listed possessions that had several reasons for their significance, often spanning across the boundaries set by the activity. There was often a blurred distinction between someone's individuality (i.e. the unique set of characteristics that define their autonomy) and their interpersonal affiliations. Participant's affiliations were in some cases seen as distinguishing features of their personal identity, particularly in family ties: *"inside I have a picture of my two granddads who have both passed away so in that regard it's very special as well"* [P9, locket]. Other possessions did not blur the lines between identity facets in their meaning but would bear significance for multiple reasons: *"we'd go riding together so that was a social thing, but I also liked the fact that it was my possession. It was a nice bike and I used to clean it all the time"* [P6, bicycle]. In this instance, the meaningful possession fulfils both *affiliation-seeking* and *autonomy-seeking* motivations (Kleine et al., 1995) by stressing signs of connectedness with a friend while simultaneously emphasising individuality through the ownership of a particular bike.

## 3.3.2 Object Interventions

It was difficult to predict the results of asking participants to replace a range of common household items with a set of similar objects for a two-week period. Our aims were therefore largely explorative, looking at how people rationalise their differing emotional perceptions between similarly-functioning objects.

### *Object Selection*

The most commonly chosen substitute object was the mug (9 out of 10 participants) and the least commonly chosen was the plant (1 out of 10 participants) with all others chosen by 3 to 7 participants. This result could be influenced by a multitude of factors. Participants that did not own an object prior to the study that fit within a certain object category had the presented object removed from their available selection. The thought process described by participants also varied with some selecting objects that would cause the least amount of inconvenience while others sought those that they believed would be the most disruptive and noteworthy over the two-week period.

### *Object Ratings*

At the end of the two-week study period, participants were asked to position each of the six original and six substitute objects within an area to indicate the degree of *me-ness* and *emotional attachment* attributed to each of the objects. As may be expected, objects that were owned by participants prior to the study greatly outperformed those that were introduced for the two-week period. Still, the purpose of the interventions was not to compare related objects on even grounds, but rather to provide a point of comparison to enrich participant responses.

The act of substituting familiar household objects with similarly functioning objects led participants to think more deeply about the items that are so heavily integrated into their daily lives: *"That [substitute] is a better mug but it is completely meaningless to me and it irritated me [...] because it wasn't this [original] mug. It wasn't something that every night I would reach for automatically"* [P2]. Some object substitutions left participants feeling indifferent: *"They're the same. They're just tea towels"* [P5] while others had dramatic variance between the introduced object: *"I don't like it... wouldn't have it in my home"* [P2, substitute visual art] and their own: *"when I look at this painting, I remember all of these different things. I remember the physical place, [...] I remember a great holiday"* [P2, original visual art]. The physical attributes of the substitute objects often had a significant impact on their ratings among participants. They were often positively received when their physical attributes were associated to existing possessions: *"I have a similar one so it's already something that I'm appealed to"* [P9, substitute plush toy] or people: *"it made me*

*think of my mother [...] orange has always reminded me of my mother"* [P8, substitute visual art].

Overall, participants expressed negative or apathetic sentiment when discussing the introduced objects: *"There is no attachment; there is no meaning to them. There's nothing intimate about them*" [P8] and positive or enthusiastic sentiment in regard to their prior objects: *"I've come to really like it and identify it with me at home"* [P7, original mug]. With only minor differences in the functionality of the original and substitute objects, why might there be such a dramatic difference in the way they are perceived?

Some participant's ratings were impacted by their perceptions of ownership over the objects: *"it's not my mug. I knew it [substitute] wasn't my mug whereas that one [original] I know is mine"* [P9]. Objects were often rated within the *me–not me* scale for their relevance to participant's tastes: *"I wouldn't normally have that style"* [P3, substitute lamp], *"it's the colours I like"* [P7, original vase].

The emotional attachment felt towards an object was often dictated by the memories it evoked: *"that mug reminds me of an enormous amount of stuff for a period of my life. All sorts of things, travel things, a completely different culture"* [P2] or lack thereof: *"there's no history behind it [...] this came from nowhere"* [P4, substitute plush toy]. This attachment could stem from its origin, containing memories of an experience: *"what gave it value was how it was given, how I received it"* [P8, original key ring] or place: *"it has a stronger emotional attachment for me because I got it in Singapore"* [P3, original sculpture]. Objects that were considered not me but to which they felt strong emotional attachment often did not reflect the tastes of the owner but had strong associations to a friend or family member through the act of gifting, outweighing their discontentment with its physical characteristics: *"I would never ever choose to display it but because [close friend] chose to give it to me and it was so heartfelt [...] I cannot pull myself to put it away"* [P2, original figurine]. Conversely, objects that were considered me but devoid of emotional attachment had strong associations to the personal attributes of the owner but no significant history: *"they're straight forward, they're simple to use, […] they're practical which is more my end of it"* [P3, substitute pen].

### 3.3.3 Interviews

The three key themes and eight sub-themes (see Table 2) discerned in the thematic analysis of the participant interviews were the result of rigorous coding of 115 units of text arising from discussion of both the *identity timelines* and *object interventions* activities. These key themes are *selfhood*, *life story* and *selfhood and life story*, the latter describing instances where a participant spoke in relation to both selfhood and life story within the same thought. This overlap of themes formed its own separate theme as it was deemed significant when participants referred to selfhood and life story in relation to each other. Selfhood relates to the set of qualities that constitute a person's individuality, including their personality, values and beliefs. A life story consists of the series of autobiographical events that a person connects to form a coherent narrative of their life (Linde, 1993).

| **Theme / Sub-theme** | **Description** |
|---|---|
| Selfhood | The set of personal characteristics that define an individual. |
| Attributes | Attributes, characteristics, qualities or function of the possession. |
| Associations | Associations, ties or links to ideas, aspects or activities external to the possession. |
| Values | Principles or standards of behaviour, one's judgment of what is important in life. |
| Life Story | The series of events making up a person's life. |
| Person | Reference to a person or people other than the participant. |
| Non-person | No reference to a person or people other than the participant. |
| Selfhood and Life Story | Reference to both selfhood and life story. |
| Combination | Both selfhood and life story positively contributing to the value of the possession. |
| Contrast | Selfhood and life story conversely contributing to and detracting from the value of the possession. |
| Comparison | Comparing or weighing the importance of selfhood and life story in their contribution to the value of the possession. |

**Table 2. Thematic Analysis themes, sub-themes and descriptions.**

### *Selfhood*

Many of the assessments made by participants were derived from their personal values, beliefs, interests and preferences, all of which distinguish them as an individual. These characteristics are reflected by the objects that participants cherish, providing glimpses of a past, present or anticipated future identity.

The values of some possessions were described by their physical attributes such as colour, style, functionality or aesthetics: *"the pram is very functional; it's a very good design. People say it's the Mercedes Benz of prams"* [P4]. Others gained value from the associations formed by participants, creating links to prized aspects of their personality: *"I like dictionaries and I like the way they look, and I like the way they're arranged. It appeals to my library sense of order"* [P2].

### *Life Story*

Alternatively, the significance of possessions stemmed from their place within the life story of the owner. In this case, the value of the possessions is derived from its relationship to a past event, life period or place. The past experience may be seen as a profound moment: *"my dad taught me how to ride the bike […] it was one of those moments where you think your dad is holding on to you and he lets go so I still remember exactly the spot and everything"* [P4] or a period of self-development: *"that book is a representation of a transition, a massive transition, from a little country bumpkin to somebody who could hold their own and did well at school and who got into uni and who took all the opportunities"* [P2]. The recollection of significant aspects of one's life story can in itself influence the feelings assigned to possessions (Gubrium & Holstein, 2000). The question is raised; was the possession significant at the time of its involvement within a participant's life, was it only significant retrospectively or did it gain additional significance with the passage of time? Future product attachment studies that utilise longitudinal methods could provide a greater understanding of this relationship between ongoing development of identity and shifting perceptions of possessions.

### *Selfhood and Life Story*

In a number of cases, participants identified both selfhood and life story significance in their discussion of a possession. The reasoning for cherishing a possession often alluded to both its relevance to the values of its owner and the fond memories it is associated with:

*"I had good memories of abseiling and going camping at school. I like it also because it's functional as well. It actually does something, it's not just decorative"* [P4, original key ring].

In other instances, responses would reflect a contrast between its value as a functioning object and the memories it cues: *"it's actually quite annoying but it reminds me of my father"* [P4, alarm clock]. In these instances, the sentimental value of the possession within a participant's life story outweighs its lacklustre physicality: *"it's completely useless […] but it just reminds me of where I started"* [P2, book].

This interplay between aspects of an individual's set of values and their memories and experiences is also weighed against one another: *"I do like the ring itself but it's more representing who gave it to me"* [P9]. This comparison shows the varying degree of significance the range of factors bear in the overall perceptions of a possession.

The separation of notions of selfhood and life story is difficult to establish and define. The life story of an individual undoubtedly influences their current perceptions of selfhood and vice versa when reconstructing distant past memories (McAdams, 2001). This is demonstrated when a participant fondly recollects past experiences of cooking with loved ones: *"a lot of my earliest memories are cooking with my grandmother"* and later describing cooking as a central aspect of their individuality: *"I love cooking [...] it is one of the defining things about me"* [P2]. While this link between past social experiences and current perceptions of self-identity can be identified from the responses given by a participant discussing their collection of cookbooks, the cause and effect relationship of these two aspects of identity are not often traceable. Still, we believe possessions can provide inklings of these inseparable aspects of a person's identity.

### 3.3.4 Perceptions of Meaningful Digital Objects

Several participants were reluctant to list certain digital and physical-digital objects as meaningful possessions: *"I hate valuing technology to that extent but my laptop basically has my life on it"* [P9], *"I didn't want to put it because there's that stigma of Facebook being your life but I think practically it forms my social identity"* [P7]. Despite their reluctance, in both cases participants refer to the large role these possessions have within their current lives. Other participants similarly described the broad significance of digital possessions in their current lives: *"they allow me to communicate with people"* [P5], *"it is such a massive part now of my social identity"* [P2, social media accounts] but their responses were devoid of

reference to the characteristics of the digital object itself. This contrasted the significance of aesthetic qualities for several physical possessions: *"It's heavy, it's solid, it's silver—it's a beautifully designed [key ring]"* [P2].

## 3.4 Discussion

In our analysis of reasoning for the emotional significance or identity relevance of objects we present the overarching themes and trends of participant responses. While these findings are likely to be influenced by the small number of participants, their ages and their backgrounds, we do see value in considering these results in conjunction with the related studies that informed its structure and aims. We also acknowledge the differences in object attachment across cultures, such as differing emphasis on individuality and conformity (Wallendorf & Arnould, 1988), that further undermines over-generalising our findings. In the following section we discuss the ways in which meaningful objects often contain an array of personal meanings and outline a potential method of promoting product attachment within design practices.

### 3.4.1 Physical and Digital Objects

Digital possessions that were emotionally significant to participants reflected identity-based motivations in a similar manner to their physical counterpart. Participants did however convey a sense of shame when discussing their valued digital possessions. We see this stigma of cherishing digital possessions as a notable barrier to creating emotionally significant digital objects that has been largely overlooked by the HCI community.

Several participants highlighted the importance of a sense of ownership in their reasoning for valuing or not valuing objects involved in the study. The prevalence of cloud-based storage of digital media can diminish feelings of ownership (Odom et al., 2014). While the *placeless* nature of digital objects offers users the convenience of access almost anywhere, it can also act as a barrier to the development of emotional significance. Our findings emphasise the relationship between place and the reasons provided for cherishing a possession. A tie would not be suitable at the beach, just as a pair of swim shorts would not suit an office environment. These objects are designed for, and associated with, the identity that people portray in the contexts in which they are used

and seen. This poses a challenge for the design of *placeless* digital objects to be either constrained within, or adapt to, varied contexts that bring about particular aspects of one's identity.

### 3.4.2 Diverse Meanings

Our findings revealed a number of instances where a possession mentioned by a participant contained multiple reasons for their significance with value stemming from both the personal and social self, autonomy and affiliation-seeking motivations, or a combination of past, present and anticipated future identities. The notion of objects containing several distinct meanings is not novel. In their analysis of object meanings, Csikszentmihalyi and Rochberg-Halton (1981) identified 7875 meanings within the 1694 objects involved in their study, averaging close to four meanings per object. Despite this multitude of identified meanings, they suggest that *individuality* and *relatedness*-based motivations for valuing an object are mutually exclusive, something that our findings did not support. We found several instances of objects being valued for both the *individuality* and *relatedness* they emphasise through their use, ownership and associations with examples outlined in our findings. This closely aligns with Brewer's (1991) established social psychology model of optimal distinctiveness in which social identity ties are strongest when they *"simultaneously provide for a sense of belonging and a sense of distinctiveness"* (p. 475). An example from our study is a locket owned by P9 containing photos of her two grandfathers. The locket itself stresses individuality through its personalised contents while simultaneously providing a sign of connectedness with her family.

Instances of objects containing several distinct meanings such as the example given above were found to be the norm rather than the exception in our participant responses. This may have been influenced by the comparative nature of our probing activities but does suggest that the strength of attachment an object evokes is directed by *summative* evaluations of several traits that each enhance or diminish its overall significance to the individual. This clustering of separate meanings can occur from differences in the perception of an object's materials, functionality, style and the memories, values, beliefs or experiences associated with it.

Previous studies that have explored reasons underlying peoples attachments to objects often delineate and categorise meanings to determine their relative prevalence and therefore merit in efforts to design for product attachment (Golsteijn et al., 2012; Kleine et al., 1995; Schifferstein & Zwartkruis-Pelgrim, 2008; Schultz et al., 1989; Sherman & Newman, 1978; Wallendorf & Arnould, 1988). These studies often analyse the *primary* meaning of an object in isolation of other factors that may enhance or diminish its significance for the individual. We see the clustering of meanings identified in our findings as a central component of emotionally significant objects that should not be overlooked in efforts to design for product attachment. Several design strategies for promoting product attachment propose focusing attention on evoking a particular determinant of attachments, for example designing products that evoke enjoyment (Schifferstein & Zwartkruis-Pelgrim, 2008) or stimulate social contact (Mugge, Schoormans, et al., 2005). Our findings suggest a need to holistically consider the scope of product properties that may enhance or diminish attachment experiences in efforts to promote the formation of meaningful user-object relationships.

### 3.4.3 Insights for Design

Many of the personal reasons for cherishing a possession found in the responses of our study and those of previous studies have not yet been addressed in the development of strategies and recommendations for promoting product attachment within design practice. Internal processes involved in attachment experiences such as the formation of product-related memories and assignment of meaning are seemingly disconnected from design decisions that occur within product development processes. More often than not, attachments develop over time through recurring interactions between owner and object (Kleine & Baker, 2004; Thomson et al., 2005) rather than through appraisal of its designed properties. Chapman (2014b) addresses this in stating *"material things do not contain meaning, but rather, they trigger meaningful associations within the perceiver"* (p. 142). Objects cannot be inherently meaningful, but rather they become meaningful when they are assigned personal significance by an individual. The results of our study also highlight some of the challenges involved in designing for product attachment. Most notably, each individual's self-identity and life story represent unique interests, values,

behaviours, experiences and tastes that are further muddled by the variances that exist between facets of identity within an individual.

Examples from our findings suggest that design processes may however be able to influence the formation of personally meaningful associations with new products among intended users. Evidence for this can be seen in P8's response to the newly introduced visual art piece's strong use of the colour orange, reminding her of her mother. While this example is not the result of conscious design intentions, it does illustrate the potential for material, functional or contextual properties to be thoughtfully designed to evoke meaningful associations to an individual's memories or social ties. Carefully considering an intended user's personal history and perceptions of product properties such as materials, colours, textures and aesthetic imagery to intentionally evoke particular associations may provide a promising direction for promoting attachment experiences in the early stages of ownership.

Designed properties of the meaningful objects discussed with our participants were also associated with their sense of self; aligning with the values, behaviour and tastes of the individual. This alignment represents association between features of an object and aspects of the owner's identity, such as P3's appraisal of a *straightforward* and *practical* pen in connection to his own practical-minded identity as an engineer. Associative imagery may be utilised by designers—for example through the use of product metaphors (Hekkert & Cila, 2015)—as a strategy to better align new products with the values users portray in their context of use.

## 3.5 Conclusion

The design study presented in this chapter explored people's relationships with cherished and newly introduced possessions. Insights were made into the significance of possessions in developing, reinforcing and redefining the various facets of one's past, present and anticipated future identity. The study revealed that people often have multiple sources of meaning that are assigned to a possession, with these meanings often relating to their personal values and life experiences. Findings showed that objects were primarily valued for their associations to meaningful events, relationships, achievements, life periods and values of the individual. These findings were used to discuss how the design of new products and systems can promote product attachment by facilitating associations between an object and significant aspects of one's selfhood or life story. Links between the ongoing developments of identity, the recollection and reconstruction of a life story and the role of meaningful possessions highlight the potential of bespoke approaches to designing for product attachment. In the following chapter, we build upon our findings by applying these insights to the design of new products targeted towards the unique identities and life narratives of individuals to further reveal the potential for design to promote meaningful user-object relationships.

# 4

# DESIGNING MEANINGFUL OBJECTS

In Chapter 2, we established the definitive link between meaningful objects and self-identity. In Chapter 3, it was found that relationships between objects and a person's self-identity are layered and associative in nature. In some instances, these relationships were a direct result of responses to the material, functional or contextual properties of the object that are shaped by design decisions. In this chapter, we outline an approach to applying insights generated in Chapter 3 to design practices. We created six artefacts that were inspired by interviews conducted with three individuals who discussed details of their life stories. We then evaluated the associations that came to mind for our participants when interacting with these newly designed artefacts to determine whether these links brought meaning to them. Our findings highlight the potential of design to bring emotional value to products by embodying significant aspects of a person's self-identity.

This chapter is based on:
Orth, D., Thurgood, C., & van den Hoven, E. (2018). Designing objects with meaningful associations. *International Journal of Design, 12*(2), 91-104.

## 4.1 Introduction

Product attachment has been extensively studied across a range of disciplines with contributions made to advance theory on why and how people come to cherish their belongings. It is generally understood that people develop an attachment to an object for its role in the construction, maintenance or development of an aspect of their self-identity (Ball & Tasaki, 1992; Csikszentmihalyi & Rochberg-Halton, 1981; Schultz et al., 1989; Wallendorf & Arnould, 1988). These objects can be used to express personal values, engage in fulfilling activities or reflect ties to friends and family. While substantial contributions have been made to advance our understanding of why and how people develop an attachment to their possessions, little progress has been made towards applying this theory to design practice. Studies that evaluate user relationships with existing possessions, such as the study presented in the previous chapter, often point towards meaningful memories and associations as key determinants for strong degrees of attachment (Csikszentmihalyi & Rochberg-Halton, 1981; Kujala & Nurkka, 2012; Page, 2014). Despite their prevalence in the product attachment literature, the potential value of using meaningful memories and associations to promote product attachment has not yet been explored in design practice.

We investigate whether it is possible to purposefully create meaning by evoking meaningful associations. This chapter outlines our process in applying product attachment theory to the design of six bespoke artefacts inspired by interviews conducted with three individuals who discussed details of their life stories. Each artefact was designed with the goal of containing meaningful associations to aspects of the intended user's self-identity and life narrative. We evaluated the associations that came to mind for each participant while interacting with the designed artefacts to determine whether these ties brought meaning to them. We reflect on our design process to discuss the effectiveness of our approach and the resulting artefacts in promoting the formation of meaningful associations with objects. We conclude by exploring the applicability and limitations of our findings alongside existing design strategies for promoting attachment.

## 4.2 Method

As our research goals related to bridging the gap between product attachment theory and design practice, we chose to apply a research through design approach (Frayling, 1993), creating a range of bespoke artefacts intended to contain meaningful associations with aspects of the participant's self-identity and life narrative. In this section, we provide an overview of the procedure we developed for the three phases of our study. Each of the three phases involved in our process is then described in greater detail together with the resulting findings in the subsequent section of this chapter.

### 4.2.1 Participants

A total of six artefacts were created based on the life narratives of three individuals. As our focus was on creating objects that could be used in constructing a coherent life story, we chose participants in middle adulthood, between 45 and 65 years old. We believed this demographic would possess a rich life history while still holding anticipations for their future. Participants were recruited from the broader social networks of the researchers. As reward for their involvement, participants were able to keep any of the artefacts designed for them. Further participant details are provided in section 4.3.1.

### 4.2.2 Phase 1: Inspiration

We conducted in-depth semi-structured interviews in which we asked participants to discuss their life stories (Linde, 1993). These interviews were intended to reveal details of the participant's identity narratives, much like the work of Ahuvia (2005), which investigated the life history and loved possessions of ten individuals. We saw life stories as an appropriate means of gaining an understanding of participants' lives and individuality as they *"express our sense of self"* (Linde, 1993, p. 3). It is worth noting that life stories are *reconstructions* of a person's experiences that are both subjective and fragmented in nature (Polkinghorne, 1995). A life story is also a social unit exchanged between people through conversation and the re-telling of past experiences. We acknowledge that our interviews are limited in the breadth, depth and continuity of information they provide, capturing mere glimpses of the re-presented lives of our participants. Nevertheless, the life stories shared with us still provide a wealth of rich data to inform the subsequent phases of our study.

Interview questions followed three distinct areas. Firstly, we began by asking participants to share their life narrative, directing discussion from their childhood to their current life and finally their plans and aspirations for the future. Discussion pertaining to participants' life narratives comprised the majority of the interviews. Secondly, we asked them to discuss things they deemed personally significant, including traits they valued in others and their ties to people, places, experiences and possessions. Finally, we concluded by asking participants to share their thoughts on various physical properties such as colour, texture and material. Interviews were conducted in the homes of participants and ranged from one to two hours. All participants appeared at ease in their response to questioning, openly sharing personal stories, values and aspirations throughout the interviews.

### 4.2.3 Phase 2: Creation

We used the stories shared by our participants as inspiration for the design of several artefacts. Our design process followed the goals of Zimmerman's (2009) philosophical stance on *designing for the self* which *"asks designers to make products as intentional companions in a user's construction of a coherent life story"* (p. 396). We aimed to translate elements of the participant's life narrative and sense of self to the designed artefact. This translation was intended to facilitate the formation of emotional value in the artefact through its ability to characterise and communicate significant memories, experiences and values held by the user.

In our analysis of the interviews, we first transcribed the data and extracted stories, experiences and values that held potential for their significance or ties to physical characteristics that could be translated into an artefact. Selected data was then coded for its links to aspects of the self-identity or life story of the individual, for example a past personal achievement or an ongoing mother-daughter relationship. We then created several clusters of data that could be merged into singular design concepts. These clusters were judged for the significance, clarity and number of associations that could be incorporated into our design process. Finally, we selected the two most promising clusters from each of our three participant interviews to resolve into six designed artefacts.

To appropriately express the values and meanings that came from our participants' life stories into a physical artefact, we gained insight from Hekkert and Cila's (2015)

analysis of product metaphors. Much like product metaphors that translate *"abstract concepts into concrete product properties"* (p. 199), we used imagery from our interviews with participants to shape our designs. This translation process is not intended to create artefacts that merely mimic the stories shared by our participants, but for our artefacts to be *meaningful* in the eyes of their user. This goal is both ambitious and difficult to measure. In discussing design that attempts to induce emotions or experiences for users, Hassenzahl (2004) states that designers *"can create possibilities but they cannot create certainties"* (p. 47), a sentiment that we agree with.

All artefacts were created by the author, an industrial designer with several years of industry experience. The ideation process was conducted in a similar manner to traditional design practice with a range of sketched concepts explored prior to the creation of the final six artefacts. Stories, experiences and values shared by our participants during interview sessions were highly effective in providing inspiration and direction for the design process.

### 4.2.4 Phase 3: Evaluation

To evaluate the effectiveness of our designed artefacts in developing meaningful associations for the user, we devised *Object Associations* cards (see Figure 11) that asked participants to list all associations that come to mind when engaging with a specific object including memories, experiences, events, places, time periods, people, things, emotions, values, personality traits or qualities. Our instructions promoted the inclusion of responses ranging from specific to vague or from meaningful to mundane. We asked participants to complete an *Object Associations* card for three of their self-selected cherished possessions at the start of our initial interview sessions to gain an understanding of the types of associations they ascribed to their valued belongings. Participants were later given three of the six designed artefacts and asked to complete an *Object Associations* card for each received artefact over a two-week period.

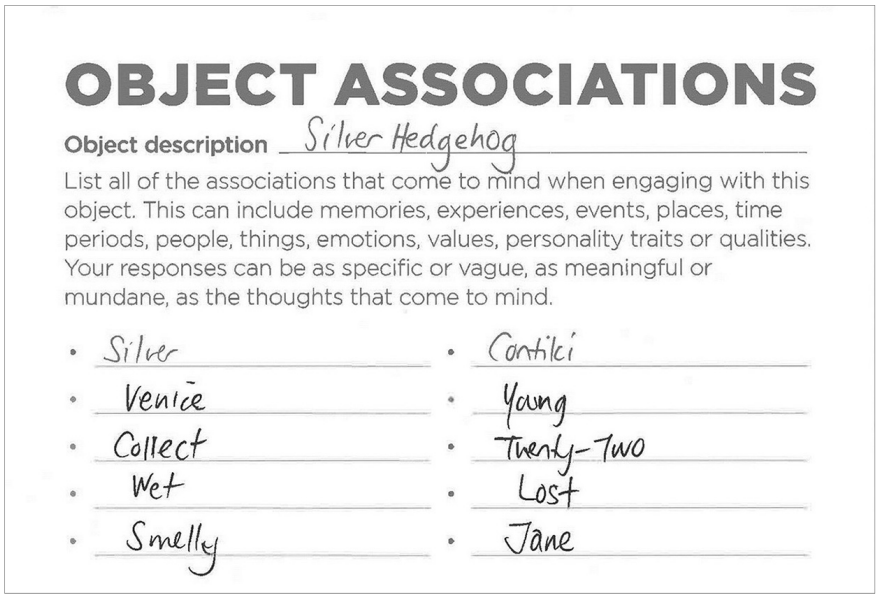


**Figure 11. An *Object Associations* card.**

Each participant received the two artefacts designed from their own shared narratives and one designed from the narrative of another participant. They were not informed of the sources of inspiration or underlying intentions of the three artefacts they were given. In determining which of the artefacts designed for another participant they should receive, we selected the artefact that we believed most closely aligned with their identity. Participants were asked to incorporate each of the received artefacts into their normal routines throughout the two-week period. We concluded by conducting a second interview with each participant to discuss their reactions and the associations they listed for each of the artefacts they received. These evaluative interviews were transcribed and analysed alongside reflections on the design process to determine the effectiveness of our approach.

The study was introduced to participants as an exploration of the thoughts that objects can bring to mind. Participants were not given any information regarding the source of inspiration for the artefacts they received or our design intentions until they had completed their involvement in the study. We wanted our participants to infer the associations or meanings of the designed artefacts on their own accord. Knowledge of our design intentions could have influenced the responses provided by our participants (cf. Da Silva, Crilly, & Hekkert, 2015).

## 4.3 Design Process and Findings

We present our findings within the three phases of the devised design process: gaining inspiration, creating the artefacts and evaluating participant responses. Findings from each of our participants are treated in isolation to maintain the depth and diversity that came from their involvement.

### 4.3.1 Phase 1: Inspiration

In this section, we provide a brief overview of each of the life narratives re-presented in the interview sessions. These semi-structured interviews discussed participants' past experiences, current lifestyle and hopes for the future.

*Alex's Life Narrative*

Alex[1] is a 56-year-old father of three with a career in IT sales and client management. He lives with his partner near the northern beaches of Sydney. Alex's upbringing was fickle as his family moved around Australia every few years to follow his father's professional role in the army: *"there was always something different going on—different house, different town, different school friends"*. This *nomadic* lifestyle continued in his adult life as he lived and worked in various countries across the globe and developed a passion for travel.
While these ongoing movements across the globe bring volatility, Alex has maintained continuity in his life through his social connections: *"I'm a communicator […] I write to people […] I've always made the effort to keep in contact with my friends."* Alex brings continuity to his wealth of travel experiences through his belongings. His home is filled with refined objects of art, paintings and books that act as *souvenirs* of his travel experiences.

Despite having a successful career, Alex separates his professional life from his sense of self: *"I don't define myself by my career […] I've worked very hard at it, but it hasn't been the central part of my being"*. This disassociation between Alex's career and his identity coincides with his anticipations for the future following retirement, freeing time for writing, travelling and being a pro-active granddad.

[1] All names used are pseudonyms chosen by our participants.

### *Louise's Life Narrative*

Louise, 48, is a mother of two working in human resources. She grew up in a rural town on the east coast of Australia, accustomed to being out in the surrounding native bushland with her older brother: *"we used to spend a lot of time out in the bush. We were fairly conservative kids."* Both of Louise's parents worked at the local high school which brought about certain responsibilities: *"we really knew the boundaries and I think we were also conscious of not embarrassing our parents."*

Louise eventually left home to attend university in another rural town 400 kilometres away, giving her a strong sense of freedom. She has since lived and worked in Australian cities and enjoys travelling with her husband and two children. Looking forward into the future, Louise hopes to return to living in a rural area to *"live a more simple life"* with *"less stuff to do, less stuff to have, less noise, less disruptions."*

### *Karen's Life Narrative*

Karen, 58, works in accounting and lives in a heritage-style Sydney home with her partner and two miniature schnauzers. She was born in central England where her father worked as a coal miner and her mother a homemaker for her and her five siblings. Karen's family moved between England and Australia several times throughout her childhood, impacting her school life: *"I was constantly going to different schools and that's very hard for a shy child."*

After finishing high school and transitioning into young adulthood, Karen lived and worked in various places across Australia and New Zealand. She developed several hobbies: *"I used to sew […] I used to knit […] I used to go to tech to learn wedding cake making and decorating […] I really loved doing that."* Karen has kept her love for creating over the years however changes in her lifestyle have limited her ability to do so: *"I had more time I think […] my job wasn't as stressful. My life's different now. I do miss it"*. In more recent years, Karen's two pet dogs have become a central part of her life. In the future, Karen hopes to move to a small city off the south coast of Australia with her partner and two dogs to lead a more relaxed lifestyle.

## 4.3.2 Phase 2: Creation

The following section details the inspirational stories and design decisions that culminated in the artefacts created for each participant.

### *Alex's Artefact: Globe*

Alex's life-long love of travel led us to consider ways we could bring about positive memories of various experiences through interactions with an object. We set out to design a world clock, providing links to other places around the world. This process resulted in *Globe* (see Figure 12) a 24-hour clock that displayed a city that was currently enjoying happy hour (five o'clock to six o'clock in the evening), shifting to a city in the next time zone each hour.

Many of the cities included in the clock contain their own unique associations related to Alex's past-self either as an individual through his solo travels or more recently through shared experiences with his daughter: *"when [she] finished school […] she and I went off by ourselves to the Middle East and Italy"* and his partner: *"it was freezing cold when we were in Moscow."* We also included several remote cities that may have not yet been visited by Alex to create potential associations to his future anticipations for further travels to new destinations.

The unique set of experiences related to each of these cities led us to conceal time zones while outside of the happy hour period, allowing greater focus to be given to each city in isolation. The intended effect was to create moments of unexpected reflection as the clock is read at various times throughout the day, each time showing a different city in which people are finishing work for the day.


**Figure 12. Globe: a world clock.**

### *Alex's Artefact: Kiruna*

Alex's valued possessions reflected his love for *objects of art* as he described his appreciation for the craftsmanship involved and the stories they often reflect. We set out to create a sculptural object that drew inspiration from his personal stories to reflect his affiliations to both delicate materiality and narrative. This process resulted in the creation of *Kiruna*, a porcelain decanter (see Figure 13). Porcelain was used for its associations as a precious material: *"you have to look after it, if you drop it and break it, it's very hard to repair it"*, which contributes to Alex's appreciation of sculptural artefacts.

In determining the form of the decanter, we drew inspiration from Alex's description of himself as *"much more a winter person than a summer person"* and the significant experience of when he *"mastered skiing for the first time, when I made it down an American mountain without falling down"*. Skiing has also been an activity Alex shares with his children: *"the kids took it up when they were two and three"*, creating rich ties to family, places and experiences. *Kiruna* draws inspiration from the imagery of snowy mountains beneath a clear blue sky. Indentations were made in the body of the decanter to reflect the snow tracks created through the act of skiing back and forth down a mountain.

**Figure 13. Kiruna: a decanter.**

### *Louise's Artefact: Diramu*

Louise's rich experiences of growing up in rural Australia *"surrounded by bush"* were a central theme of the stories she shared. Australian native bushlands reflect both her past identity and anticipated future identity beyond retirement as she looks forward to one day returning to a *"more simple"* rural lifestyle. We drew inspiration from her rich recount of bushfires approaching her family home before being doused by her parents and the local fire department: *"I have these really vivid memories of trees, full trees, being on fire."* This imagery was used in the design process of *Diramu,* a scented candle with a transparent cover sleeve (see Figure 14). We used a smoky, campfire scented candle in conjunction with silhouettes of native Australian trees to create a sensorial experience of a flickering light and scent reminiscent of Louise's vivid childhood memories. A candle was used for the calming effects of its gentle scent and soft lighting, paring back the intensity of the bushfire imagery and reflecting Louise's future anticipations of leading a less stressful lifestyle amongst bushlands.

**Figure 14. Diramu: a candle cover.**

### *Louise's Artefact: Geo*

Louise's role as a mother of two young boys played a definitive part in the recent stages of her life narrative, providing a source of joy through their shared experiences. We found inspiration in her and her youngest son's shared appreciation of patterns: *"he's right into geometric tessellations and he's really mathematical and so he loves all that and I've kind of grown to love that as well."* Louise also had a personal appreciation for various styles of textiles, patterns and textures including *intricate paisley and floral design*, *the art deco era* and *the grain of the wood*.

In our design process, we set out to create a set of placemats and coasters to be used during family dinners that reflected Louise's youngest son's love of geometry and her own personal attraction to the art deco aesthetic. The resulting design *Geo* (see Figure 15) drew inspiration from the art deco movement to create intricate, geometric shapes cut from stained wooden sheets to reflect Louise's identity as a mother and as an individual.

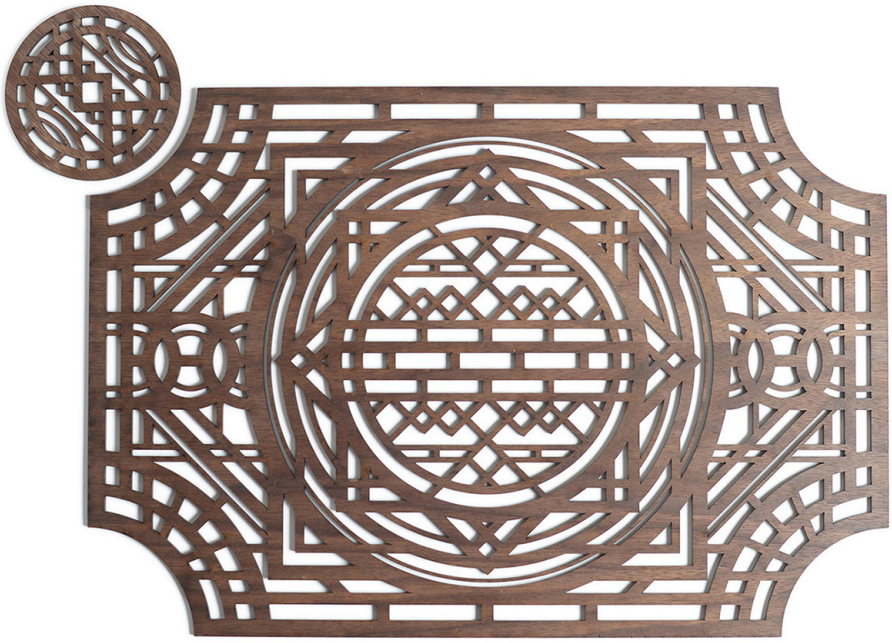

**Figure 15. Geo: a set of placemats and coasters.**

### *Karen's Artefact: Crater*

Karen's relationship with her father as a child was a source of some of her fondest memories: *"very alike my dad and I […] I miss him*". We drew inspiration from her vivid recount of daily routines: *"I always remember my dad coming home from one of his shifts with his black coal face"* and the experiences they shared: *"Dad would always collect me from school and I always remember his big hand holding my hand."*

In our process, we sought ways of using the imagery of coal to bring about positive memories of Karen's father, resulting in *Crater* (see Figure 16). We were cautious to avoid the common associations of coal as dirty and instead aimed to treat the material as precious, using a piece of anthracite coal much like a gemstone. We saw the coupling of coal with worn jewellery as an ideal way of reflecting the significance and closeness of Karen's relationship with her father. The coal piece also invited further engagement through its tactility, containing smoothed edges that fit within a person's hand.

**Figure 16. Crater: a pendant necklace.**

### *Karen's Artefact: Dyad*

Karen's love for her partner and two dogs were ties we tried to draw upon in our design process. In our interview, Karen vividly described the distinct personalities of each of her dogs: *"He's very loving, very affectionate, he's cheeky, […] she's reserved, she's serious."* In a similar way, Karen described herself and her partner as *opposites* and likened her reserved dog to her partner. We tried to reflect the opposing yet harmonious personalities of Karen and her partner and her two dogs in the design of *Dyad*, a set of indoor pot plants with character-like features (see Figure 17).

In our process of creating *Dyad*, we drew inspiration from Karen's love of creating, particularly her history of knitting and sewing. We adopted a technique of needle felting wool roving to convey distinct personalities between the two pots. Grey wool was used to suggest a sombre tone and her partner's preference for an industrial aesthetic of stainless steel, while a mixture of vibrant red and orange hues reflected Karen's personal affiliations: *"I was born in autumn, so I like all those [colours]."*

**Figure 17. Dyad: a set of pot plants.**

### 4.3.3 Phase 3: Evaluation

In this section, we discuss the associations that participants recalled from their own cherished possessions at the start of our initial interview sessions and the associations assigned to the designed artefacts by the end of the two-week evaluation period. There was a possibility that participants' knowledge of the study may influence the associations they assigned to our designed artefacts by recalling the stories they shared with us and identifying our design intentions. We questioned participants at the end of their involvement in the study and found this not to be the case in any instances.

For both the cherished possessions and the introduced artefacts, participants described associations to significant people, places, experiences, time periods, events and emotions. When asked to elaborate on these associations, it became clear that they ranged from signifiers of specific events to providing vague feelings that were at times difficult to describe.

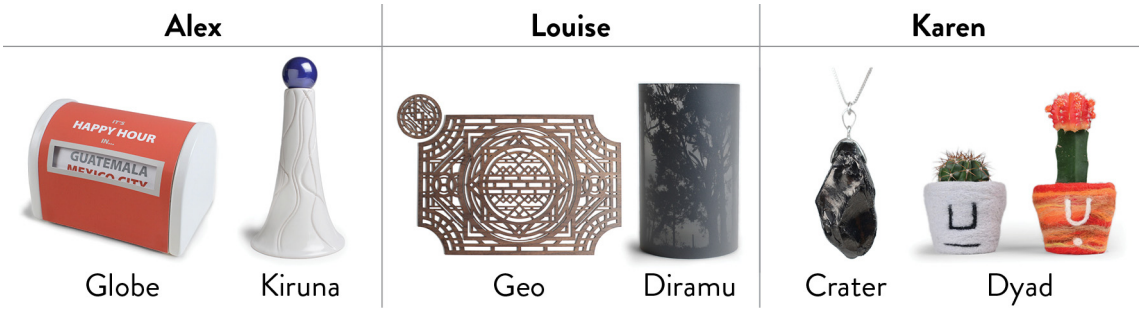


**Figure 18. Summary of the artefacts designed for each participant.**

*Alex's Associations*

Alex's self-selected cherished possessions were his teddy bear, a Russian hat and a framed oil painting of an Australian landscape (see Figure 19). Each of these items possessed a rich shared history of ownership with associations to significant people, memorable experiences and fond time periods in his life. Associations reported by Alex also linked to broader ideas such as *legacy*, *security* and *new life*, providing insights into the ways in which these belongings are appropriated as part of creating a coherent life narrative and robust sense of self.

**Figure 19. Alex's cherished possessions: teddy bear, Russian hat and oil painting.**

Alex's experiences and responses to the designed artefacts were varied. The porcelain decanter *Kiruna*, which was deliberately designed for him, was associated with positive aesthetics, being considered *elegant* and *attractive* as it tied in with his personal appreciation for artistic objects: *"I'm a ceramics person"*. Alex did not form associations relating to his love for skiing or winter activities, instead seeing parallels in the colours to Greece and going on to question its practicality as a decanter.

The world clock *Globe* was also designed specifically for Alex and was associated with many of his travel experiences: *"it reminded me of memories of Timbuktu, Florence, Moscow, Dubai, Tashkent…"* however, it was ultimately viewed in a negative light. This could be attributed to a multitude of reasons. The clock itself was found to cease functioning for the two-week period in which it stayed in Alex's home, nullifying the intended experience of use. *Globe* was also developed as much more a prototype than a finished product when compared to the other designed artefacts and his own cherished items, potentially lowering its perceived aesthetic quality and value. While *Globe* was successful in forming associations with Alex's rich history of travel experiences as we intended, it did not gain meaning in doing so: *"I have wonderful memories of about three quarters of those cities, but that thing doesn't reflect those."* This raises the issue of *authenticity* in designing objects with meaningful associations in which the overall perceptions of the object may not align with those ascribed by the user to the associated source.

Alex was also given the candle cover *Diramu* which, while not intended for him, evoked fond memories of his experiences of North American forests: *"my first trip to America was in the middle of winter […] the sun set early so the night-time, which the candle sort of implies, is half my memories of that initial trip."* While Alex recognised the Australian bushfire motif, he had no personal connection to it. Instead, his perceptions were shaped

by his associations with the product category of candles, both geographic: *"Candlelight in my mind is a very North American, northern hemisphere should I say type of light"* and temporal in nature: *"the only time I ever seem to have candles in the house is Christmas, so it reminds me of Christmas."*

The product categories that Alex perceived each of the designed artefacts to fit within played an integral part in the way they were perceived. Alex's established views of ceramics as often *elegant*, souvenir shop items as *useless* and candlelight as *northern* intertwined with the memories each item brought to mind. These associations either reinforced or undermined one another, influencing the overall strength of the links.

### *Louise's Associations*

Louise included a pair of ruby earrings, a Moorcroft vase and a small silver hedgehog figurine as some of her most cherished items (see Figure 20). Each item contained a number of rich stories with links to significant people, places, emotions and events. Associations reported by Louise would encompass a broad picture of her experiences including both the good (*beautiful, carefree, love*) and bad (*noise, smelly, death*).

**Figure 20. Louise's cherished possessions: ruby earrings, Moorcroft vase and silver hedgehog.**

Louise's interactions with the designed artefacts similarly reminded her of significant people, places, events and time periods. The set of placemats and coasters *Geo*, specifically designed for her, reminded her most strongly of her two children for varying reasons: *"[eldest son] loves woodwork and [youngest son] loves geometric designs."* The intricate patterns were associated with folk art from Latvia, her husband's country of birth. While we gained inspiration in the design process from Louise's youngest son's interest in complex geometry and were successful in reflecting this in our design, we were not able

to predict the additional family ties it would elicit. These strong associations ultimately represented a broader view of the family's future based on the development of their current identities: *"these were more about possibilities and what the kids might do in the future and the things that they're interested in."*

Louise's interactions with the candle cover *Diramu*, also specifically designed for her, evoked vivid childhood memories of the night her family home was saved from a nearby bushfire. When lit, the candle *"brought back these amazing memories"* as the visual effect it created *"looked like the night"* and the smell it released *"was like the burning of eucalyptus"*. Louise's encounter with a bushfire as a child could have potentially been a negative or even traumatic memory. Its role in our design was reliant upon our interpretations of the way in which Louise discussed the memory in our interviews. She explained that the experience the candle evoked for her *"wasn't a scary feeling at all"*, instead it was *"like being in […] a pleasant bushfire, not an unpleasant bushfire."* Beyond this vivid association to a childhood memory, Louise recounted the ill-defined thoughts it brought to mind: *"the smell of it had a certain… I don't know… feeling of home."*

Our design intentions were successful in evoking Louise's vivid childhood memory of bushfire in a calming and pleasant manner. When asked to rate and discuss the candle's value to her, Louise described it as *quite emotive* and *very meaningful* because of its rich personal associations: *"it tapped in to something that was […] a really strong memory for me."* The effectiveness of *Diramu* may be due to its specific and somewhat literal representation of an aspect of Louise's life narrative, providing a definitive link as opposed to the more abstract representation utilised in other designs.

The decanter *Kiruna*, not designed for Louise, was the third artefact given to her and of the three, the one she associated with least. The form of the porcelain decanter was likened to frozen water. This imagery supported Louise's interpretation of it to be *cold* and *aloof* in character: *"it felt like it didn't want to be interacted with."* Despite describing the piece as *beautiful*, the associations it brought to mind for Louise were contradictory to her own sense of self: *"we're kind of messy wood people so it wasn't something I felt an affinity with"*. While Louise found the decanter to reflect imagery similar to our intended snowy mountain, she had no personal connection to this imagery.

### *Karen's Associations*

Karen's relationship with objects in general was distinctly different to our other participants. In our initial interview, she described herself as someone who does not assign sentimental value to her possessions. After further discussion, she was able to identify three possessions that she cherished: her car, a sewing machine and the house she lived in (see Figure 21). Karen's car and sewing machine were not associated with any specific memories, but rather positive feelings such as *enjoyment*, *safety* and *comfort* that came about through their use. The house Karen lived in had a more extensive group of associations, linking to her partner, her dogs, the feeling of coming home and a rich history of her life in recent years.

**Figure 21. Karen's cherished possessions: her car and her house.**

Karen's initial reaction upon being given the first item designed for her, the necklace *Crater*, was that it reminded her of her father. Although she responded positively to the necklace: *"it's quite nice, I quite like it"*, it did not hold any significance to her: *"I didn't grow any attachment to it."* This acts as another instance in which our design successfully evoked an intended association for the user but the emotional significance of the source, Karen's relationship with her father, was not transferred to the object. This highlights a key challenge to designing objects with meaningful associations in which the designed artefacts do not have an extensive shared history with the owner. This lack of history may discredit the authenticity of the association in the eyes of the owner, as the object *cues* but does not *embody* a significant part of their identity.

Karen was also given the set of pot plants *Dyad*, designed for her and the set of placemats and coasters *Geo* (not designed for her). While *Geo* was positively received: *"I just loved them. I used them every day"*, neither of the two sets of artefacts evoked significant associations for Karen during the two-week period. Although this was an ineffective result

for the design of *Dyad*, Karen provided greater insight into her connection to objects by using the dining table we sat at during the interview as an example:

> *I've had this table a very long time. I've had lots and lots of good dinner parties […] this could tell a thousand stories […] but I'm not attached to it […] I can let it go tomorrow. If you wanted this tonight, I'd say take it. It doesn't mean much to me.*

From reflecting on the transcript of our initial interview, it became clear that Karen would rarely assign meaning to an object but rather engaged in several meaningful *practices* throughout her life. She fondly recalled her love for cooking, cleaning, sewing, knitting, baking and decorating that extended from her youth to adulthood: *"I loved the process […] I just loved doing it."* While *Dyad* gained inspiration from Karen's love for knitting, it did not reflect the process, but rather the resulting outcome which often held little emotional value.

We see this variation in the ways in which people engage with their belongings as a signifier of product attachment as a construct that fits within a broader context of *meaning making* that occurs through people's ongoing relationships to places, people, practices, experiences or things.

## 4.4 Discussion

We set out to apply product attachment theory to our design practice to better understand the ways in which design can support users in engaging in a process of meaning making and identity construction through their relationships with products. In doing so, we entered a dialogue with our participants in which they provided inspiration for and responses to a range of designs intended to reflect aspects of their identity and life narrative. The experiences of our participants while engaging with our artefacts highlight the various ways in which people evaluate objects through their inferred associations. In this section, we reflect on our design process and resulting artefacts to highlight key opportunities and considerations for designing objects with meaningful associations.

### 4.4.1 Opportunities and Considerations in Designing for Product Attachment

Our process of incorporating significant memories and associations within a designed product contains several promising aspects for promoting product attachment. Firstly, the active inclusion of meaningful associations brings emotional value to the object in the initial stages of ownership, much like the value often assigned to a family heirloom or thoughtful gift upon receipt. This contrasts with existing design strategies that rely on attachment to develop over an extended period of time through everyday interactions (Mugge, Schoormans, et al., 2005). Secondly, the degree of attachment established from meaningful memories and associations is often argued to be greater than other determinants of attachment (Niinimäki & Koskinen, 2011; Page, 2014; Schifferstein & Zwartkruis-Pelgrim, 2008), leading to a stronger emotional bond between the product and user.

Although our artefacts and process were effective in many ways, there are also several limitations to what we as designers can achieve in promoting meaningful user-object relationships. A person's need for self-expression is finite (Chernev, Hamilton, & Gal, 2011), thus there is a limit to the number of possessions an individual will use to represent their individuality. This may hinder the integration of new products into their established sense of self. In addition to this, designers cannot design an emotional experience, they can only design *for* an emotional experience as emotions are ephemeral and dependant on context (Hassenzahl, 2004). Designers are therefore limited to create possibilities instead of certainties in any attempts to design for product attachment.

The approach outlined in this chapter also contains further limitations to its application in practice. To elicit a desired associative response, designers are faced with the difficult task of anticipating another person's reaction to the products they create. This requires an empathic approach to understanding a user's needs, values and beliefs. Our artefacts were also designed for a single individual with inspiration derived from their unique life story, an approach that is often not possible in traditional design practice. This limitation is partly inherent to the way in which people form attachments to their belongings. Previous studies have highlighted that the experience of attachment is unique to the individual (Niinimäki & Koskinen, 2011) and that it is not possible for one design to have emotional value for all intended users (Desmet et al., 2001). Nevertheless, we see

potential for meaningful associations and an empathic approach to be utilised in several scenarios such as designing for specific cultural groups, as they often form similar inferences about a product (Allen, 2006) or designing personalised jewellery (e.g., wedding rings). In addition to this, advancements in custom manufacturing technology such as 3D printing provide growing opportunities for bespoke design practices such as those presented in this chapter as an alternative to traditional mass production processes.

### 4.4.2 Reflecting on Our Design Process

Much like our own study, designers often make use of characters and narrative data within their ideation processes to guide design decisions and encourage alternate viewpoints, most commonly seen in the use of personas (Cooper, 1999). These personas and other similar methods risk providing an over-simplified view of users by generalising and summarising information prior to the ideation phase of the design process (Golsteijn & Wright, 2013). In our approach, we saw merit in using in-depth research methods to gain a greater depth of understanding of the complexities and nuances of real life contexts that design practices work within (Wrigley, Gomez, & Popovic, 2010). Our interviews were successful in providing sufficiently rich data to use as inspiration for our bespoke designs. We found our participants' detailed stories of specific experiences were particularly useful for generating concepts, providing us with vivid yet focused design directions. Although our implementation of semi-structured interviews may have limited the amount of storied responses we received (Golsteijn & Wright, 2013), we found this approach crucial to understanding the different ways in which our participants perceived underlying aesthetic elements of objects such as material, colour and form.

We saw value in continuing our in-depth approach in the development and evaluation of our bespoke designs. In doing so, we endeavoured to create artefacts that were closer to finished products than conceptual prototypes, allowing our participants to engage with them in the same way they would their own household belongings. We focused predominantly on the imagery and materiality of the object to reflect the life stories of our participants, resulting in designs that were more decorative than functional. This was partly due to production constraints involved in creating one-off designs but also part of our attempt to create simple designs that limit the amount of possible associations that were beyond our understanding of the individuals we were designing for.

The potential value of using the functionality or interactivity of objects to facilitate meaningful associations remains an unexplored area for future work. Additionally, the growing presence of digital components within products brings new challenges to designers seeking to promote attachment (Kirk & Sellen, 2010). Further exploration of the value of meaningful associations within the digital realm would provide insights relevant to the shifting nature of product design practice. We explore the value of meaningful associations evoked by technological products in Chapters 5 and 6.

In our evaluation of the emotional significance of a range of designed artefacts, we adopt the argument that attachment is definitively linked to the self. This led us to focus our attention on the associations assigned to various objects to determine whether they were generic or personal in nature, asking participants to elaborate on the thoughts that come to mind to understand whether these links brought meaning to them. The six bespoke artefacts that resulted from our process received mixed reactions from our participants. In most instances, we were successful in creating intentional associations between an object and a personal idea. Some artefacts were even able to *cue* specific memories and experiences. We are reluctant to make any claims of the meaning ascribed by participants to any of our designs due to the small sample of artefacts involved, the short time frame of the experiment and the subjectivity of participant responses. Our most notable example of an object that may hold genuine meaning would be in Louise's response to *Diramu* in which she described it as *quite emotive* and *very meaningful* for its links to her childhood. From this, we see our artefacts as examples of the potential for design to tap into user's internal processes of meaning making or identity construction and our design process as an effective way to guide the ideation and development of bespoke products.

### 4.4.3 Creating Meaning

In our study, we set out to create objects that tapped into meaningful imagery already in the minds of our participants. In doing so, we intended to facilitate the formation of emotional value in an artefact through its ability to characterise and communicate significant memories, experiences and values held by the user. Our six designed artefacts reflect mixed results in achieving these goals. We use these mixed results to propose two

conditions that are required in designing objects with meaningful associations: *cueing meaning* and *authentic embodiment*.

### *Cueing Meaning*

Some of our artefacts reflected an aspect of a participant's sense of self but were not deemed overly significant in doing so (see *Kiruna*). This issue relates to the *identity salience*, that is, *"the relative importance of a given identity in an individual's self-structure"* (Kleine et al., 1993, p. 223) that is associated with the object. What a person considers to be a meaningful aspect of their identity is continually changing throughout their lifetime as their sense of self develops (Kleine et al., 1995). To hold meaning for an individual, an object must cue aspects of their identity that are considered meaningful, whether it be their personal values, relationships with others, past experiences or hopes for the future.

Although the notion of *cueing meaning* is simple in theory, it is difficult to achieve in practice. The porcelain decanter *Kiruna* held ties to Alex's self-view as a *ceramics person*, yet this aspect of his identity was not in itself significant enough to bring meaning to the object in the two-week period. Designers must employ an empathic approach to understand the relative importance of an individual's experiences, values, beliefs or relationships. An example of this empathic approach can be seen in our decision to use Louise's recollection of a *pleasant bushfire* as the primary source of inspiration for the candle cover *Diramu* despite bushfires usually being perceived in a negative light. The results of our study suggest that cueing memories of specific experiences was more meaningful than reflecting a general time period, value or belief. We found the specificity of these events allowed for more engaging design representations. These cued memories of a specific event (e.g., a bushfire) were also found to trigger associations to a broader context within a person's life narrative (e.g., childhood, summer and home), however associations to a broad concept (e.g., family) did not trigger memories of specific experiences.

### *Authentic Embodiment*

Some of our artefacts *cued,* but did not *represent,* a significant aspect of a participant's self-identity (see *Globe* and *Crater*). Despite cueing an emotionally significant source (e.g., Alex's travel experiences), the meaning of this source was not transferred to the object. Creating objects with meaningful associations requires the user to perceive the

associations as *authentic*, that is, they must perceive the object to successfully *embody* the associated source of meaning. Our design for the world clock *Globe* cued memories of Alex's travel experiences but was also likened to common souvenirs, relating to a style of travel that Alex actively avoids and thus detracting from the authenticity of the embodiment. This issue of authenticity can be likened to the concept of *identity relevance* (Reed et al., 2012) in which a product symbolises a belief, goal, value, or identity. Symbolic meaning often develops from the proximity of the object to the source of meaning (Belk, 1988) such as a kitchen knife used to prepare meals shared with friends and family or a pair of gloves worn while gardening. Our findings suggest authentic embodiments can also be created by tapping into the meaningful imagery already in the minds of intended users (see *Geo* and *Diramu*). To create associations that are perceived to be authentic, designers must consider an intended user's pre-constructed understandings of product categories and features such as the materiality of the object, the product experience and beliefs of the kind of person who would use or own such an object.

## 4.5 Conclusion

Product attachment theory suggests that people develop an attachment to an object for its role in the construction, maintenance or development of an aspect of their self-identity. These objects are often assigned emotional value for their associations to memories, experiences, values, aspirations, people or places. We set out to explore the potential for design to promote the formation of product attachment by developing a process of designing objects with meaningful associations, using the life story of our intended users as inspiration for the creation of several artefacts. Our evaluation of these artefacts reflected mixed results that highlight the need for designers to consider both the *importance* of an associated aspect of identity and the *authenticity* of the embodiment itself to create objects that hold meaning for an individual. We intend for the process and resulting artefacts presented in this chapter to inspire designers to further explore the value of meaningful associations in their practice to enrich user-product relationships.

# 5

# MEANINGFUL PHYSICAL-DIGITAL OBJECTS

Chapter 4 detailed the design process and evaluation of six physical products inspired by an intended user's life story as a means of facilitating the formation of personally significant associations. The process resulted in mixed results that provided insights for creating meaningful objects through product design practice. This chapter builds upon these insights to consider products containing digital functionality and the effects this has on attachment experiences. The physical-digital duality of technological products further complicates the internal processes involved in ascribing meaning to a belonging. We conducted semi-structured interviews and two probing activities with twenty participants to investigate the associations formed between everyday physical-digital products and a person's self-identity to identify similarities and differences to non-digital product attachment experiences. The findings showed that digital components were often the primary source of their meaning and material devices were perceived to be important but replaceable.

This chapter is based on:

Orth, D., Thurgood, C., & van den Hoven, E. (unpublished manuscript). Designing meaningful products in the digital age: How users value their physical-digital possessions.

## 5.1 Introduction

Technological advances have rapidly created opportunities for designers to integrate digital functions into physical products. This new category of physical-digital products has become increasingly integral in people's day-to-day lives, seen in the vast prevalence of devices such as smartphones, laptops, tablets, e-book readers, game consoles and digital cameras. These products have become central to the ways in which many people communicate with others, conduct business and spend their leisure time. Ongoing advances in the Internet of Things and cloud-based services continue to expand the breadth and prevalence of this physical-digital category of products moving forward into the future.

While this fusion of physical and digital components has great potential for improving the harmony between humans and products, it requires consideration of how the combination of tangible and intangible form influences the ways in which we as humans develop emotional relationships with our belongings. Despite their significant role in people's lives, physical-digital products are often replaced far before their functional lifetime expires (Huang & Truong, 2008). The Consumer Technology Association (2014) report the average smartphone functional life expectancy to be 4.7 years however several studies show the average consumer replaces their smartphone in the first 12-24 months (Deng et al., 2017). This rate of consumption referred by Huang and Truong (2008, p. 323) as a *"disposable technology paradigm"* amplifies a number of sustainability issues such as resource scarcity and e-waste management (Deng et al., 2017). From a sustainability perspective, promoting emotional user-object relationships through design has been considered as a viable strategy to address issues with the rate of product consumption (Gegenbauer & Huang, 2012; Huang & Truong, 2008). When attached to an object, people are more likely to handle it with care, to repair it when needed and to postpone its replacement (Belk, 1991).

Several researchers within the HCI community have looked at the role of a possession's form in the development of attachment by comparing the ways in which people develop emotional ties to their physical, physical-digital, and digital possessions (Denegri-Knott et al., 2012; Golsteijn et al., 2012; Odom et al., 2014; Petrelli & Whittaker, 2010; Turner & Turner, 2013). The findings of these studies suggest that

people are less likely to value their digital or physical-digital possessions as highly as their physical possessions. The underlying causes for these differences in emotional value are not yet fully understood. It remains unclear why people develop less of an emotional connection with physical-digital products such as smartphones than non-digital products. Early work has suggested this is a result of the concealed functionality of technological products such as the hidden components and processes that allow a camera to capture a scene and store it as a digital photo. This is argued to cause a conceptual separation between what a thing *is* (a camera) and what a thing *provides* (digital photos), thus diminishing the emotional value of the thing itself (Borgmann, 1984; Verbeek, 2005) however there is limited empirical evidence to support this view.

This chapter explores the ways in which people perceive and value their physical-digital possessions to better understand the nature of attachment when both physical and digital forms are integrated within a single product. Within this, we aim to address a question posed by Feinberg (2013, p. 7) in her conceptual look at possessions in the context of HCI: *"at what level of abstraction does attachment lie?"*, drawing distinctions between a person's attachment to a particular device versus the digital information stored within the device. We address this question by isolating and comparing the physical and digital components of technological devices to determine the source of their value and at what level of abstraction it is assigned. We asked 20 participants to list the associations that come to mind when engaging with either physical or digital components of their physical-digital possessions. We then conducted semi-structured interviews that elaborated on the listed associations and concluded by asking our participants to comparatively rate and discuss the meaningfulness of physical and digital components of these possessions. We use these findings to generate insights for designers seeking to create lasting technological devices by promoting the development of attachment within this increasingly prevalent design space.

## 5.2 Method

Our research interests primarily involved exploring differences and similarities in the ways in which people perceive and value the physical and digital components of their physical-digital possessions. Our emphasis on dividing and isolating the physical and digital stems

from the reported differences in meaning across these object categories and a need for more sustainable technological product consumption. Designing physical-digital products with greater emotional value has potential for extending their lifetime, but only if this value is assigned to the specific object. Our intention to explore the nature of attachment and its level of abstraction within people's relationships with certain possessions contains several challenges. It can be difficult for people to describe the idiosyncratic complexities of the attachment felt towards a possession (Richins, 1994). This issue is amplified by the difficulty of conceptually distinguishing between multiple aspects of a singular possession. To address this, we devised two probing activities to aid participants by structuring a process of isolating and comparatively rating various components of their physical-digital possessions. We then conducted semi-structured one-on-one interviews with participants to discuss their responses to the probing activities and aid our understanding of their underlying thought processes.

Our method was inspired by probe methodology, a design-oriented user research process first introduced by Gaver et al. (1999) and since adapted to a variety of research purposes within the design and HCI communities (Boehner et al., 2007; Mattelmäki, 2005). Probe methodology generates deeply personal data that we felt effectively aligned with the highly subjective nature of attachment experiences and the need for more in-depth explorations of these experiences to compliment the summative findings of previous studies (Golsteijn et al., 2012; Odom et al., 2014; Petrelli & Whittaker, 2010). While our usage of probe methodology aligns with its three fundamental qualities—being design oriented, concerning the users' subjective world and being based on self-documentation (Mattelmäki, 2005), our adaptation of the method deviates from its original function. We use probing activities to generate *information* rather than *inspiration* and to act as an agent for insightful dialogue with our participants, much like Crabtree et al. (2003) and Hemmings, Clarke, Rouncefield, Crabtree, and Rodden (2002). In this section, we provide an overview of our procedure and the activities and materials that formed our study.

### 5.2.1 Participants

Research sessions were conducted with 20 individuals (11 female, 9 male, aged 22-63) who owned and used physical-digital products for both personal and professional purposes. We aimed to recruit a participant pool that contained an even mix of male/female, a spread of age and a range of professions. This was done to account for the richness of varying individual experiences rather than attempt to produce generalisable theory, much like Denegri-Knott et al. (2012). Sessions took place in either the participant's home or a private space near their workplace. All participants were recruited from the broader social networks of the researchers and came from a diverse range of professional fields such as engineering, education, IT, accounting and healthcare. As reward for their participation, a small donation of five dollars (AUD) was made to a charity of their choice.

### 5.2.2 Procedure

We conducted semi-structured interviews and two probing activities we describe as *association cards* and *meaningfulness ratings* that divide and compare the perceptions and value ascribed to physical and digital components of participants' physical-digital possessions. Participants were instructed to select their three most important physical-digital possessions (e.g. phone, laptop, tablet, game console, e-book reader or camera) and if possible, bring them to the session. We asked participants to select possessions that were important rather than meaningful to allow for richer comparisons of product significance. These instructions were also deemed more likely to include products used in a workplace that may also extend one's sense of self but are not often perceived as archetypal examples of meaningful possessions (Tian & Belk, 2005). Completion of the study, including probing activities and interviews took between 30-60 minutes per participant.

#### *Association Cards*

The first probing activity involved a series of *association cards* shown in Figure 22 that asked participants to list all associations that come to mind when engaging with one of three components (object, collection, item) of their selected physical-digital possessions. We first deployed a*ssociation cards* in the study of physical objects in Chapter 4 (Orth et al., 2018) and have since iterated the cards to suit the comparative objectives of the

reported study. This iteration process involved a piloting session in which eight individuals were asked to complete an object, collection and item association card by following the instructions written on each card. Amendments were then made to the design and phrasing of each card based on the feedback provided.

Associations are often discussed in attachment literature as a determinant of attachment and a key source of a product's emotional value (Battarbee & Mattelmäki, 2004; Kujala & Nurkka, 2012; Mugge et al., 2008). This includes ties to memories, loved ones, material and experiential qualities, usage scenarios and facets of self-identity. Associations can also arise from reflective thoughts and feelings or imagined futures derived from memories (Zijlema, van den Hoven, & Eggen, 2016). By asking participants to list associations we intended to reveal differences in the ways in which each aspect of the possession is perceived and how these differences in perception translate to their assigned value. Participants were first asked to list associations related to the physical *object*. Second, they were asked to list associations related to a selected digital *collection* contained within the possession such as a library of music, photos, videos, games, podcasts, apps, programs, emails, messages, contacts or working files. Finally, they were asked to list associations related to a single digital *item* within the selected digital collection such as an individual song, photo, video, game, podcast, app, program, email, message, contact or working file. A complete overview of the activity, including descriptions of objects, collections and items was provided prior to completing any lists of associations. Participants were informed that associations may include memories, experiences, events, places, time periods, people, things, emotions, values, personality traits or qualities. Our instructions promoted the inclusion of responses ranging from specific to vague and from meaningful to mundane. These instructions remain open to a broad scope of associations beyond meaningful relationships as we were also interested in the perception of a possession in the absence of meaning to aid our comparative analysis.

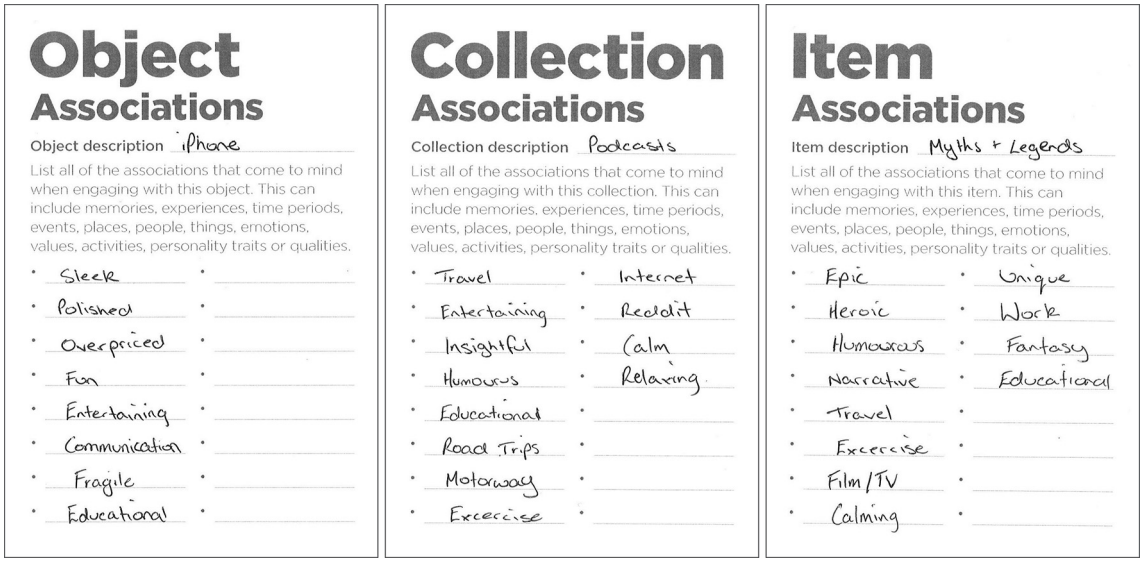


**Figure 22. A participant's (P12) *object*, *collection* and *item* association cards describing the associations evoked by their smartphone.**

We distinguish between the physical and digital by referring to each as an *object* or *item* respectively. We found this phrasing to minimise confusion whilst piloting study activities as many people did not think of digital media as objects. Previous studies that intended participants to openly select physical and digital possessions have used inclusive phrasing by requesting *special things* (Petrelli & Whittaker, 2010) which they suggest may have led to the inclusion of few physical photos and few digital collections of media. We also believed it was important to distinguish between digital contents as either collective or singular to better address our goal to understand the level of abstraction of attachment in physical and digital contexts. Digital collections and items are often studied separately or comparatively in the HCI community (Belk, 2013; Feinberg et al., 2012; Petrelli & Whittaker, 2010). Due to the often-blurred boundaries between a digital collection and item we remained open in allowing participants to determine what they considered to be collective or singular. For example, a social media app may be considered a collection of conversations with friends or a single piece of software that belongs to a broader collection of apps used on the device.

### *Meaningfulness Ratings*

The second probing activity asked participants to rate each of their object, collection and item association cards on a scale from *meaningless–meaningful*. We use these terms as an abstract measure of attachment that is consistent with the methodology of previous

studies analysing people's relationship with physical-digital possessions in an exploratory manner (see Blevis & Stolterman, 2007; Denegri-Knott et al., 2012; Gegenbauer & Huang, 2012; Odom et al., 2009). Studies aiming to quantify product-related attachments have traditionally assessed responses in relation to the criteria of *irreplaceability* (Kleine et al., 1995; Schifferstein & Zwartkruis-Pelgrim, 2008; Schultz et al., 1989). This can be problematic when comparing the personal significance of physical and digital belongings as the irreplaceability of a digital possession can be difficult to conceptualise (Feinberg, 2013) and may unduly influence participant responses. The concept of meaningfulness was seen to provide an even field of measure across physical and digital forms and to also provide an indication of emotional significance, a characteristic that is strongly correlated with measures of attachment (Ball & Tasaki, 1992). Participants were asked to discuss their interpretation of meaningfulness while completing their ratings to ensure there was consistency across responses. They were also instructed to rate the specific thing described in their card, for example, to rate the meaningfulness of their specific phone rather than phones in general. We adopted the usage of a spatial scale over the more commonly used Likert scale to offer participants a more intuitive approach to comparatively consider each aspect of their physical-digital possessions. Each card was plotted along a shared axis to emphasise comparative ratings.


**Figure 23. A participant's (P15) spatial ratings from *meaningless* (left label) to *meaningful* (right label) for association cards relating to their smartphone, desktop computer and game console.**

*Interviews*

We concluded by conducting semi-structured interviews with each participant to discuss their completed responses to the two probing activities. Participants were asked to further explain each of the associations listed within their object, collection and item association cards. This was done to clarify the thought process that led to their inclusion, whether the association was personal or objective in nature and to determine its level of specificity such as whether it relates to a single or recurring experience. Finally, participants were asked to provide reasoning for the meaningfulness ratings given to each of the association cards. This included prompts to compare the ratings assigned to the object, collection and item associations of the same possession and ratings across all three selected physical-digital possessions.

### 5.2.3 Data Collection and Analysis

Collected data included completed *association cards*, photos of each participant's *meaningfulness ratings* (as shown in Figure 22 and Figure 23 respectively) and audio recordings captured during the interview sessions. All interviews were transcribed to provide further context in the coding of listed associations and analysis of self-reported reasoning for the value ascribed to product components in participants' *meaningfulness ratings*. Each listed association was coded by the first author using association categories developed in an iterative analysis of the data. Seven categories were derived from the meaning categories developed by Csikszentmihalyi and Rochberg-Halton (1981) and possession value categories developed by Richins (1994) respectively (see Table 3). Similar categories included in both aforementioned studies were merged to accommodate the broad scope of associations listed.

| Association Category | Meaning Category (Csikszentmihalyi & Rochberg-Halton, 1981) | Possession Value Category (Richins, 1994) |
|---|---|---|
| Utilitarian | Utilitarian | Utilitarian |
| Materiality | Style | Appearance-related |
| Literal | Intrinsic Qualities of Object | Financial Aspects |
| Symbolic | Associations \| Personal Values | Identity |
| Memories | Memories | Personal History |
| People | Immediate Family \| Kin \| Nonfamily | Interpersonal Ties |
| Experiences | Experience | Enjoyment |

**Table 3. Association categories coding scheme derived from Csikszentmihalyi and Rochberg-Halton's (1981) meaning categories and Richins' (1994) possession value categories.**

Each category was further defined and supplemented with model examples to create clear distinctions between related categories (see Table 4). Listed associations were restricted to being coded within a single category. Transcripts from each of the conducted semi-structured interviews were referred to throughout the coding process to verify the nature of each association. This was a necessary step as the word or phrase included in association cards were often ambiguous when considered without context. For example, *holiday* could be a symbolic association to leisurely travel or refer directly to memories from a specific trip. These categories were used to frame participant responses in relation to seminal work on attachment. They were also used to identify the types of associations evoked by physical and digital components and determine whether these associations reflected variance in their assigned emotional value.

| Category | Description | Examples |
|---|---|---|
| Utilitarian | What it provides<br>(efficiency, performance, features) | powerful, water-resistant, reliable<br>*"it's quite slow and annoying"* [P2, tablet] |
| Materiality | What it is<br>(appearance, style) | sleek, colourful, thin<br>*"it's a minimalist design"* [P9, smartphone] |
| Literal | What it consists of<br>(description, factual) | email, movies, camera<br>*"I have all my lesson plans on it"* [P18, USB drive] |
| Symbolic | What it represents<br>(abstract concepts, values) | career, travel, knowledge<br>*"this movie came from my childhood"* [P2, movie] |
| Memories | What memories it triggers<br>(events, time periods, experiences) | wedding, Japan, birthday<br>*"we were in a small town that sold pottery"* [P17, photo] |
| People | Who it brings to mind<br>(family, friends) | family, friends, mentor<br>*"my fiancée bought it for me"* [P11, laptop] |
| Experiences | What is done / how it feels<br>(activity, emotions) | communicating, fun, relaxing<br>*"the music can calm me down"* [P6, music library] |

**Table 4. Descriptions and examples of responses coded in each association category.**

## 5.3 Findings

In this section we present our findings that resulted from the probing activities and interviews conducted with our 20 participants. First, we provide an overview of the types of devices and digital media (both digital collections and digital items) selected and the respective associations listed. Second, we provide a summary of participants' spatial ratings and rationale for possessions that were considered highly meaningless or meaningful. Finally, we use complimentary findings from each of our activities to outline several unique characteristics of attachment in the context of physical-digital products.

| Physical Devices (n=54) | | Digital Media (n=110) | |
|---|---|---|---|
| Phone | 20 (37%) | App/s | 32 (29%) |
| Laptop | 15 (28%) | Program/s | 25 (23%) |
| Desktop | 5 (9%) | Photo/s | 17 (15%) |
| Tablet | 3 (6%) | Working file/s | 11 (10%) |
| Camera | 2 (4%) | Video/s | 7 (6%) |

**Table 5. Most frequently selected categories of devices and media.**

A total of 54 physical-digital products were discussed in the study. In some cases, participants were only able to select two possessions of which they could complete an object, collection and item association card. Participants primarily selected their most prevalent and frequently used possessions. The five most commonly selected devices and media are outlined in Table 5. All participants selected their phone as their primary device. Other products selected included game consoles, smart TVs, GPS units, hard drives and e-book readers. Other digital collections or items contained within these products that were selected included games, music, podcasts and e-books.

### 5.3.1 Association Cards

Each of the 54 physical-digital products were reported on through the completion of an object, collection and item association card. A total of 1579 associations were listed within the 164 completed association cards, an average of nine associations per card. Each of the three components of the physical-digital products addressed received a similar number of listed associations (542 object, 521 collection and 516 item associations). Out of the 1579 associations, 11 were omitted as they did not fit within any of the seven association categories. These omitted associations consisted of thoughts loosely related to the possession in question and were deemed irrelevant to the objectives of the study.

#### *Object, Collection and Item Associations*

The types of associations listed within the three product components: the physical object, digital collection and digital item were relatively consistent, as seen in Figure 24. Notable differences in the frequency of associations within each category relate most to the *materiality, memories* and *experiences* that come to mind when engaging with either the physical, collective digital or singular digital. Associations relating to *materiality* were frequently mentioned in relation to the physical form of the device such as its size, colour, texture, weight or form. In our coding process, *materiality* included all references to sensory properties, allowing for equal representation among the three components. For example, a digital photo could be *colourful*, a song could be *upbeat,* or an app could be *sleek*. Despite this, digital collections and items were often not described in this way. Digital components were associated with both *memories* and *experiences* more frequently than the physical device, a finding that contrasts previous studies comparing peoples' use of physical and digital possessions as mementos (Golsteijn et al., 2012; Petrelli &

Whittaker, 2010). In particular, digital photos frequently evoked vivid recollections of personal history: *"it captures a moment in time and a specific event, our friend's wedding, and I can remember where it was [and] what we were wearing on that particular day"* [P4].

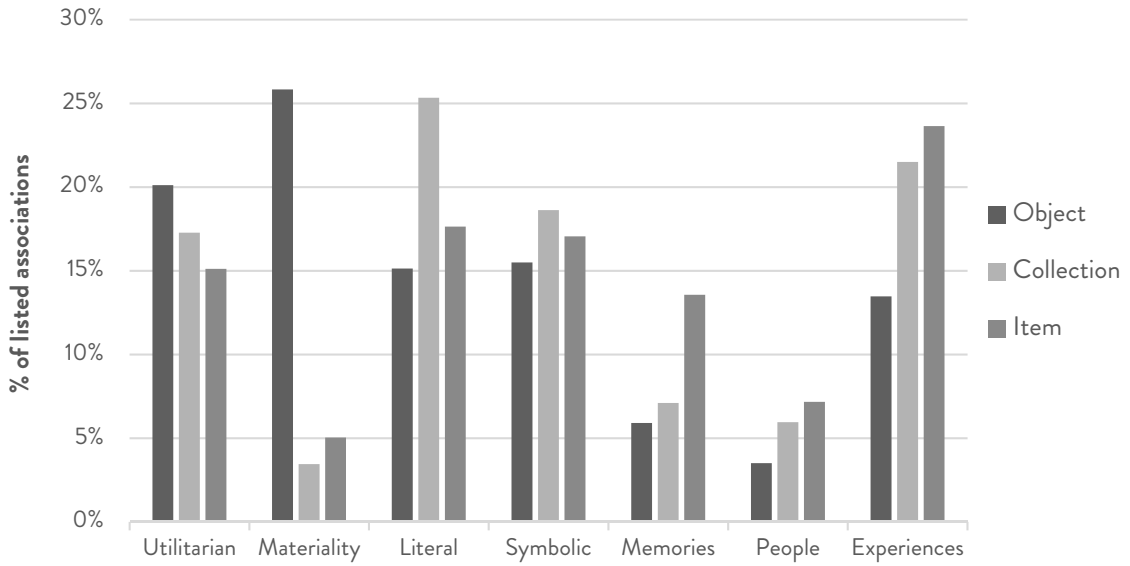


**Figure 24. Percentages of listed associations coded in each category for physical objects, digital collections and digital items.**

In our analysis of the 1579 associations listed by our participants we did not encounter specific references to the self, which was surprising given its prevalence as a signifier of meaning found in previous studies of attachment (Csikszentmihalyi & Rochberg-Halton, 1981; Golsteijn et al., 2012; Richins, 1994). This was likely due to the nature of the *association cards* task, asking for a broad range of thoughts brought to mind by possessions rather than prompting participants to more directly reflect on their possessory relationships. Interviews conducted with participants to discuss and elaborate upon the listed associations revealed several ways in which their possessions held significant ties to aspects of their self-identity that are not conveyed in the adopted coding scheme. Both physical and digital components were associated with characterising a participant's identity: *"those photos are a part of the meaning of who I am. They help define me"* [P16, photos] and expressing a sense of self: *"it's like a bit of you imparted on to it because you picked out everything and you assembled it"* [P14, desktop computer]. Connections to significant aspects of a person's identity were also found to provide unifying associations to the physical and digital components of a possession, for example P12's game console

and games collection similarly representing an aspect of his identity: *"I've kind of always personally identified as a gamer"*.

### *Physical-Digital Product Associations*

In most instances, the associations reported for the physicality of a possession had little to no relation to the digital contents they expose. For example, P7's laptop was described as *lightweight*, *sleek* and *silver* while the music library stored on its hard drive was associated with *university*, *friendship* and *gossip*. Similarly, P1's camera was described as *robust, water-resistant* and *expensive* while the photos stored within were associated with *Chinese New Year, hard work* and *Sydney harbour*. This separation of associations may be less prevalent in other forms of physical-digital possessions that were not reported such as wearable devices that more directly pair physical interactions with digital information. The few examples we found of physical devices with associations relating to their digital contents were often nonspecific such as a phone being *convenient* (P16) or *entertaining* (P12). This inconsistency in the ways in which the physical and digital components of a physical-digital possession are perceived has not yet been addressed by the HCI community. Efforts to understand differences in object form have predominantly explored differences between possessions that are purely physical or digital (Atasoy & Morewedge, 2017; Belk, 2013; Denegri-Knott & Molesworth, 2010; Gruning, 2018; Odom et al., 2014; Petrelli & Whittaker, 2010). Those that do consider physical-digital products often frame them as singular possessions akin to physical products (Golsteijn et al., 2012; Odom & Pierce, 2009; Turner & Turner, 2013). We elaborate further upon differences in the perception of physical and digital components of possessions in section 5.3.3 to outline a number of unique characteristics of attachments to physical-digital products.

## 5.3.2 Meaningfulness Ratings

All participants were able to interpret and complete the task of rating the meaningfulness of physical and digital components of their possessions. In most instances, participants positioned their association cards throughout the full spectrum of the spatial scale. As these ratings are subjective in nature, we avoid making claims of the broader significance of these possessions and instead focus on the comparative value participants ascribe to the physical and digital components in relation to one another. Broadly speaking, the

reported meaningfulness of a physical or digital component was not found to correlate with differences in the types of associations it brought to mind. The exception to this is seen with digital items rated highly *meaningful* containing associations to *memories* four times more frequently than digital items rated highly *meaningless*. This aligns with previous findings that memories are often a key determinant of attachment (Csikszentmihalyi & Rochberg-Halton, 1981; Page, 2014). While participants were instructed to rate the meaningfulness of their specific object, collection or item, this was found to be difficult to do in isolation from its broader value. In many cases, participants described the value of the product category or brand of their specific device: *"all of the other products I have are Mac so there's just a general trust with that product"* [P2, phone]. This issue of singularity was particularly difficult to define in the context of digital media with participants often valuing a song or movie highly whilst seeing their specific copy as replaceable.

### *Physical and Digital Meaning*

Digital contents were generally considered to be more meaningful than the material device. The physical object was rated less meaningful than both its collective and singular digital contents in 33 instances (61%). The majority of these physical devices contained a broad scope of digital functionality and media that extended beyond the specificity of the digital contents addressed in our study, for example a phone containing collections of apps, music, photos and videos. However rather than being assigned greater significance for their broader value and prevalent usage in daily life, the physicality of these products was often considered to be meaningless and replaceable. In contrast to this, both collective and singular digital contents were considered highly meaningful for their associations to memories, experiences, emotions, goals, values and aspects of identity. This finding addresses gaps in our understanding of attachment in the context of physical-digital products. Several prior studies concluded that people do not value their digital possessions as highly as their physical possessions (Atasoy & Morewedge, 2017; Golsteijn et al., 2012; Odom & Pierce, 2009; Odom et al., 2009; Petrelli & Whittaker, 2010). While these studies provide a comparative analysis of the different categories of possessions, they do not delve into the complex and unique nature of attachment when both physical and digital forms are integrated within a single product.

When discussing why they assigned little value to the materiality of their physical-digital possessions, many participants described their devices as interchangeable or replaceable: *"you can just go get another one so they're totally meaningless […] it's just a point-in-time object"* [P16, phone]. This finding aligns with the conclusions of previous studies that describe people's perception of physical-digital products as important but highly replaceable (Golsteijn et al., 2012; Odom & Pierce, 2009). Our results do however convey a more nuanced view of this category of products in which we place greater emphasis on their physical (carrier) and digital (content) duality. This may be due to increases in the usage and prevalence of digital services and technologies since these studies were conducted. Participant responses revealed that physical-digital products do hold personal meaning, but this meaning is ascribed at a level of abstraction beyond the singular physical object.

### *Meaninglessness and Meaningfulness*

Participant's rationale for rating a product component either meaningless or meaningful varied across the object, collection and item categories. As mentioned in the previous section, the physical object was often rated meaningless when it was seen to be interchangeable or replaceable. Other examples include devices that were rated poorly due to their functional decline. Digital collections and items were both similarly considered meaningless when they related to an aspect of life that was not perceived as significant for the individual such as TV shows and movies watched for entertainment (P10) or programs and working files used in a professional role (P9).

Objects were considered highly meaningful for a variety of reasons. This included the importance of how it was acquired such as memories associated with receiving it as a gift or the monetary expense involved in its purchase. In other instances, devices empowered participants through their functionality: *"it's a multi-task object that allows me to do so much that does add meaning to my life"* [P18, laptop]. The materiality of a device was rarely mentioned as a source of meaning. An exception to this was seen in P14's relationship with his custom-built desktop computer: *"there's a connection because I built it and because I put the effort in, and I selected the parts"*. Digital collections differed in value depending on their nature as either engaging or reflective media. Engaging media such as programs or games were considered highly meaningful for what they enable: *"without*

*that, we can't run our business"* [P4, IBM programs] and the investment made by the individual: *"a lot of time and effort has gone into those"* [P15 – games library]. Reflective media such as photo albums were valued highly for the memories they represented and the personal history they record. Highly meaningful digital items were often described as irreplaceable: *"you can't replace a wedding photo. If you lost it, you can't recreate the moment"* [P1, photo]. This included media that contained records of a personal history and social ties such as messages and conversations with close friends and family.

In the few cases of the physical and digital components of a possession being rated similarly meaningful, consistent associations were found to relate to the symbolic and experiential value of the product. For example, a phone used to stay in touch with friends being associated with *connectedness* or a personal laptop used to unwind after a day's work being associated with *relaxing*. The most notable example of this is seen with P7's phone in which both the device and the digital contents were associated with *family*, *friends*, *travelling* and *photos*. These symbolic associations created a unified sense of meaningfulness, blurring boundaries between the physical and the digital.

### 5.3.3 Characteristics of Attachment to Physical-Digital Products

Our study encouraged participants to isolate and compare the physical and digital components of their physical-digital possessions to better understand their relative significance. We found the digital components of these possessions to be rated more meaningful than the physical components in most instances. We also found associations evoked by the physical and digital components of a possession to often be unrelated. Similarly, physical-digital possessions were found to evoke highly diverse ranges of associations. We build upon these three key findings to argue that the duality of physical-digital products creates a number of fundamental differences to purely physical or digital possessions that in turn influences the ways in which people ascribe emotional value.

#### *From Singular Devices to Systems of Products*

There were often distinct divisions between the associations and meaningfulness of a product's physical and digital components. A laptop may be described as *powerful*, *sleek* and *expensive* while the music library stored on its hard drive may be associated with *cooking*, *motivation* and *travel*. The responses provided by our participants often suggested a conceptual separation between the device itself and its contents, both in the thoughts

they brought to mind and the value they were assigned. P1 conceptualised his devices as *tools*, his digital collections as *gateways* and his digital items as *"what you're trying to get to"*. P19 drew distinctions within his phone in a similar light to the human mind and body, describing the device itself as the *mechanical level* and digital contents as the *spiritual level*. This suggests that physical-digital products are in many cases perceived as a *system* of products rather than as a singular device. In this way, we see physical-digital products to be more akin to the product-system existing within a wardrobe rather than the singularity of a car assembled from many parts. A wardrobe may contain a wide range of clothes that come together to form an array of outfits. These items of clothing and the outfits they form can hold singular or collective meanings that are entirely devoid of reference to the wardrobe in which they are stored and accessed from. Similarly, the meaning assigned to a phone for its role in facilitating social connections may not be tied to the phone itself as a specific object, but rather to the apps and chat history stored within it and the empowering functionality of phones in general, as was found by Vincent (2006) and Meschtscherjakov et al. (2014). Conceptual distinctions between physical and digital product components may alter the level of abstraction of a product's meaning to its user. Existing conceptual barriers from studies of physical objects distinguish between meanings assigned to the specific object, the product brand, the product category and to objects in general. HCI research has recently explored distinctions between attachment to a digital possession, a digital collection and the *intellectual work* (Feinberg, 2013). Our findings suggest there is a need for distinctions between the hardware and software of physical-digital products in studies that report on their assigned meaning as these components were perceived as separate entities within a system. Our object, collection and item association cards provided initial traces of the assignment of meaning within the physical-digital product system. Establishing clear divisions between the various levels of abstraction in which meaning may have been assigned remains a difficult task, especially for devices that make use of ubiquitous technologies such as cloud-based storage or online streaming services. Our findings showed that in most instances, greater emotional significance was assigned at the digital levels of abstraction. We do not see this as a limitation for designers seeking to create meaningful physical-digital products, however it does place much greater emphasis on the question, at what level of abstraction will meaning be assigned?

### *Diverse Meanings*

Physical-digital products are used for a vast array of purposes that relate to personal, social and professional goals. They have become central to the ways in which people communicate with others, conduct business and spend their leisure time by containing and providing access to a vast range of digital functions and media. The breadth of usage of these devices extends further than any non-digital product. The results obtained through our use of *association cards* highlight the broad prevalence of the physical-digital products selected by our participants. The distribution of listed associations across meaning categories derived from prior studies of attachment (Csikszentmihalyi & Rochberg-Halton, 1981; Richins, 1994) showed a high level of diversity in the thoughts brought to mind by the selected physical-digital possessions. One hundred and forty (85%) of the completed association cards included associations that spanned across at least three of our seven association categories (Utilitarian, Materiality, Literal, Symbolic, Memories, People and Experiences). These ties often included references to unexpected and seemingly unrelated aspects of the user's life. For example, P19 associated a navigational app on his phone with *family* due to its usage in trips taken to visit extended family members. The lists of associations generated by our participants reflect the ways in which physical-digital possessions develop a diverse array of meanings for their owner. These products were found to no longer fit traditional object categories proposed in early attachment studies that distinguish between sentimental, utilitarian, aesthetic, social and monetarily valued objects (Richins, 1994). Possessions were valued for their pleasing aesthetics, empowering functionality and links to emotive experiences, engaging activities and relationships with loved ones. These divergent meanings vary in significance but ultimately contribute to the overall perceived value of the possession (Orth & van den Hoven, 2016).

We found the widespread usage of many physical-digital products led their value to be associated with several facets of a user's identity such as a laptop used for both professional work and personal entertainment: *"it's a multi-task object that allows me to do so much that does add meaning to my life"* [P18]. Many products were associated with several facets of life, including personal (e.g. *entertainment, relaxation*), social (e.g. *communication, gift*) and professional (e.g. *work, study, job-seeking*) activities. In contrast to this, products are often used to help define and in turn create distinctions between identity roles that

may contrast with one another, for example being both an *aggressive* financial trader and a *compassionate* father (Reed et al., 2012). While the diversity of meanings we observed add richness to the emotional value of these products, they may also diminish the clarity of their role in the characterisation and development of a sense of self for the user (Tian & Belk, 2005). Defining and segregating personas and identity roles through the use and ownership of objects has been argued to be increasingly difficult in digital contexts (Belk, 2013). Our findings suggest this may be a consequence of the diverse thoughts, memories, emotions, people and activities that become associated to physical-digital possessions through their rich involvement and prevalence in personal and social experiences.

### *Dematerialising and Dispossessing Meaning*

Our study was inspired by a question posed by Feinberg (2013, p. 7) in her conceptual look at possessions in HCI: *"at what level of abstraction does attachment lie?"*. We found varying levels of abstraction of attachment at both the material and digital level. This consequently leads to changes in the experience of attachment to a possession and the outcomes that can be expected from designing meaningful physical-digital products. Past studies of physical products have concluded that attachment often develops over time through the on-going presence and usage of a product in meaningful scenarios (Mugge, Schifferstein, & Schoormans, 2005b). This would suggest that the ubiquity and physical intimacy of devices such as phones should lead to strong feelings of attachment as they are centrally involved in many significant aspects of a person's life such as staying connected with friends and family (Golsteijn et al., 2012; Meschtscherjakov et al., 2014). In contrast to this, we found many participants to consider their selected devices to be highly replaceable.

While we believe physical-digital products can hold strong emotional value to users, this value often appears to be assigned at a level of abstraction beyond the specific, owned object. We found participants to often value a device for *what it provides* rather than *what it is,* a distinction that has been presented as a key factor in the rate of physical-digital product consumption (Borgmann, 1984; Odom & Pierce, 2009; Verbeek, 2005). Several participants discussed differences in the value they assigned their specific device and the broader product category it belongs to. P2 had developed an attachment to her phone's brand rather than the phone itself: *"I'm not loyal to this phone in particular* [but] *I would*

*always want to go back to a Mac phone […] there's just a general trust with that product"* [P2]. P6 recalled a rich history of moments shared with his phone but held no attachment to it as he felt the memories it cued could also be evoked by a replacement. The meaning assigned to the physicality of these possessions is therefore *dematerialised*. It does not relate to the product's materiality but rather its functionality or brand, which can be replaced by any other similar product. We do not see the dematerialising of meaning to *diminish* its worth, however it does raise issues in addressing sustainability challenges such as the rate of product consumption (Huang & Truong, 2008). Many researchers within HCI have explored design strategies for promoting attachment primarily for its potential to address sustainability concerns (Gegenbauer & Huang, 2012; Odom & Pierce, 2009), yet the sustainable value of attachment arises predominantly when meaning is assigned to the singularity of the device.

Digital photos, songs, videos, working files, apps, programs and games were highly valued by participants, however the singularity and sense of ownership attributed to these digital items was often blurred. Participants often had copies of these possessions either backed up on a separate hard drive, stored in a cloud-based platform or readily available to stream online. With the transition to cloud-based storage, online streaming services and collaborative consumption practices, the value of digital items has been argued to have less to do with *ownership* and more to do with *accessibility* (Belk, 2014; Odom et al., 2014). The owned mp3 copy of a song may be no more meaningful than any other digital instantiation of the same song. In this way, the meaning assigned to the digital nature of these products is often *dispossessed*. We found evidence to support this in participants' frequent referral to meaningful *experiences* rather than meaningful *possessions*: *"whenever I listen to this song, it empowers me"* [P6], *"I really enjoy the feeling of playing it. I get really immersed in it"* [P12, role-play game]. Digital media was often valued for enabling users to communicate, listen, create, curate, read, learn, play and reminisce. To summarise, our findings suggest that attachment to physical-digital possessions can exist at various levels of abstraction concurrently and most commonly relates to *digital* and *accessible* features.

## 5.4 Discussion

Our primary research goal within this project was to address the question of why people do not develop attachments to physical-digital products in the same way they do to purely physical products. To do so, we built upon the work of Feinberg (2013) to explore the ways in which people perceive and value their physical-digital possessions, comparing both physical and digital components of the product. This was done to better understand where the attachment lies within these possessions to provide insights on how designers can create lasting physical-digital products. In this section, we reflect on our use of probing activities to generate rich data and propose several approaches for designers to create lasting devices within this increasingly prevalent design space.

### 5.4.1 Reflections on our Adaptation of Probe Methodology

We employed two probing activities, association cards and meaningfulness ratings to accompany our interview sessions that explored differences and similarities in the ways in which people think about and value the physical and digital components of their physical-digital possessions. These probing activities were developed to uncover insights that may be overlooked in solely conversational methods of inquiry. Previous studies that discuss the meanings of digital possessions have found participants to be initially dismissive of their meaning (Petrelli & Whittaker, 2010) and reluctant to admit they hold personal significance (Orth & van den Hoven, 2016). The idiosyncratic complexities of attachment experiences can also be difficult for people to describe (Richins, 1994). Probing activities can provide participants with a less formal method of communicating their thoughts and feelings to bring forth insights that might otherwise remain unsaid (Wallace, McCarthy, Wright, & Olivier, 2013). Our research sessions conducted with participants began with the association cards activity openly inquiring about the thoughts evoked by physical-digital possessions without assessing the personal significance of these thoughts. More narrowly framing our association cards on the meanings of participant's possessory relationships with their physical-digital belongings—a category of products that has been found to often hold little personal significance (Golsteijn et al., 2012; Odom & Pierce, 2009)—may have filtered out data that would otherwise provide insights relevant to our research objectives.

Several limitations to the probing activities we developed were brought to light through reflecting on our findings. While participants were instructed to repeatedly report associations that come to mind at both the physical and digital level in completing Object, Collection and Item association cards, the free listing component of this activity predominantly emphasises variance in responses (Quinlan, 2017) and may have led to fewer instances of repeated associations. We also found our analysis of data generated by the two probing activities relied heavily on the proceeding discussions held with participants to further clarify, rationalise and articulate their responses. As an example, responses listed within our association cards did not provide clear ties to identity-based motivations such as characterising, expressing or developing a sense of self, despite the centrality of these behaviours in attachment literature (Belk, 1988; Csikszentmihalyi & Rochberg-Halton, 1981; Kleine et al., 1995; Richins, 1994; Schultz et al., 1989; Zimmerman, 2009). Explicit ties between reported possessions and aspects of a participant's self-identity were only revealed through elaborating on listed association and meaningfulness ratings in proceeding interview sessions. This suggests our adaptation of probing methods were susceptible to provide misrepresentative data if used as standalone methods for acquiring either information or inspiration for design processes and should instead be seen as supplementary tools to conversational methods of inquiry.

This does not necessarily detract from the potential worth of exploring new uses for probing methods in data collection processes. The spatial layout of association cards conducted in our meaningfulness ratings activity often acted as a prop to our conversations with participants, allowing us as researchers to identify patterns for further inquiry and allowing participants to reflect upon, compare and adjust their responses in real time. The positioning of ratings spatially within a shared scale emphasised comparing and weighing responses against one another. By providing physical points of comparison, we found participants were motivated to identify underlying reasons for personal significance, enhancing the clarity and certainty of their judgements. Through completing our probing activities, participants were guided through a process of conceptually distinguishing between physical and digital components of their belongings. They were then able to clearly articulate these distinctions, providing rich accounts of the thoughts and meanings evoked by their physical-digital possessions. We advocate the merit of further exploring

the use of probe methodology to sensitise participants to complex concepts related to personal human experiences and enrich researcher-participant dialogue.

### 5.4.2 Designing Lasting Physical-Digital Products

In the findings section, we have discussed several unique characteristics of attachment when ascribed to physical-digital products. These characteristics aim to highlight the opportunities, challenges and expected outcomes for designers seeking to promote attachment to physical-digital products. Most significantly, they emphasise key differences in the experience of attachment to physical-digital possessions as opposed to possessions that are purely physical or digital. These differences bring into question the transferability of findings from the study of purely physical or digital products in aiding designers seeking to create meaningful and lasting physical-digital products.

Our findings suggest that the physicality of physical-digital products is often perceived to be meaningless and highly replaceable despite their importance and prevalence in the daily lives of users. This echoes a broader concern for the rate of consumption and disposal of physical-digital products within the HCI community (Gegenbauer & Huang, 2012; Huang & Truong, 2008; Odom & Pierce, 2009). Addressing concerns related to the longevity of a product produces additional requirements to the goal of creating meaningful products. Meaningful possessions are not inherently perceived as irreplaceable (Grayson & Shulman, 2000). To become an irreplaceable possession, the meaning and the specific object must be inseparable, otherwise the product can be replaced by another that conveys the same meaning (Mugge et al., 2008). To create lasting physical-digital products, designers must ensure a product is perceived to be meaningful and for this meaning to be assigned to the specific object.

#### *Lasting Symbolic Associations*

Many of the possessions discussed in our study were predominantly valued for their functionality or digital contents. Previous studies have emphasised that for a physical possession to be considered irreplaceable, it must be valued for its material qualities as opposed to its functionality or symbolic meaning (Mugge et al., 2008; Odom et al., 2009; Verbeek & Kockelkoren, 1998). Functional and symbolic qualities are argued to be vulnerable to replacement by new products that can perform similar functions or express similar characteristics of the user. While our findings support this conclusion of the

replaceable nature of a product's functional value, our in-depth analysis of the associations surrounding physical-digital possessions suggests a more nuanced and optimistic stance on lasting symbolic value.

The symbolic associations reported by our participants related to either the present or their past and anticipated future. Symbolic associations linked with the present encompass the lifestyle and day-to-day activities performed by the user, such as a laptop used for keeping in touch with friends or while working in a corporate environment. We argue that this type of symbolic meaning is vulnerable to replacement as it relates purely to on-going aspects of the user's identity that can be characterised by any product that is used for the same goal-oriented purpose or reflects the same role. In contrast to this, symbolic associations linked to a user's past or future such as their personal history, experiences, memories or hopes for the future are much more difficult to replace as they relate to unique, specific aspects of identity such as the user's childhood or a trip taken overseas.

While symbolic associations often develop from the proximity of a product to a source of meaning (Belk, 1988), such as a pair of gloves worn whilst gardening or a photo taken at a friend's wedding, they can also arise from product properties that are a direct result of design decisions. Perceptions of a product's aesthetic properties such as form, colour, texture and size or the experience of use both produce an array of associations that vary from indistinct values to specific memories (Allen, 2002). Designers can create products that develop personal symbolic associations by employing an empathic approach to tap into the meaningful imagery already in the minds of intended users (Orth et al., 2018).

### *Meaningful Integration of the Physical and Digital*

In this section, we aim to expand on Golsteijn et al.'s (2012) discussion of the value of meaningful integration of physical and digital product components. We found distinct differences in the ways in which people describe and value the physical and digital components of their possessions. Both the physical object and digital contents stand to benefit from being more cohesively perceived and valued. Within our study, digital contents were at times seen to be irreplaceable and a rich source of meaning. Music libraries and photo albums reflected a rich personal history that continued to evolve with

each new experience. This meaning however was disconnected from the value assigned to the physical device that enabled these experiences. In their exploration of ownership experiences of consumers and their digital virtual goods, Denegri-Knott et al. (2012) found the meaning assigned to personal data to be seamlessly transferable from one device to another. They argue that this leads to a significant amount of the meaning assigned to a physical-digital product to be independent from any given device.

Many researchers within the HCI community have explored ways to more closely integrate the physical and digital components of a physical-digital product (Dourish, 2004; Fitzmaurice, 1996; Golsteijn et al., 2014; Hornecker, 2015; Ishii & Ullmer, 1997; Kirk & Sellen, 2010; van den Hoven & Eggen, 2004; van den Hoven et al., 2007; West et al., 2007). While this was initially done with the intention of improving the usability of the system (Fitzmaurice, 1996; Ishii & Ullmer, 1997), it may also improve the emotional value of the device itself. By more closely linking the physical device with its digital contents, the meaning assigned to these contents will be more likely to be associated to the specific object, potentially delaying its replacement. Conversely, materialising the meanings assigned to digital contents would provide additional properties that allow for a richer attachment experience. Our findings from coding participant's listed associations revealed that digital collections and items were rarely thought of in relation to their aesthetic and sensory properties. Materialising digital media brings forth temporal elements such as ageing with the passage of time and containing traces of usage as well as a stronger sense of ownership from its singular form (Odom et al., 2014). It also allows for greater presence in the day-to-day lives of users (Kirk & Sellen, 2010) and the opportunity for public display that can evoke feelings of pride (Brown & Sellen, 2006). While photos are easily displayed and shared with others via social media, other digital media such as meaningful programs, games, working files or music remain hidden on personal devices.

### *Materialising Meaningful Digital Associations*

As addressed above, designers seeking to create lasting physical-digital products must consider both its meaningfulness and irreplaceability in the eyes of the user. We propose that designers can materialise the meaningful associations ascribed to digital media as a strategy for both integrating physical and digital components and creating a source of

value for the physical device that is long-lasting. Instead of designing new meanings, this strategy aims to strengthen the linkage between the physical object and the personal meanings already tied to its digital contents. Meaningful associations facilitate the formation of emotional value in a product through its ability to characterise and communicate significant memories, experiences and values held by the user. The results of our study suggest that designers seeking to create physical-digital products with unified meaning must evoke associations that are specific enough to hold personal meaning for the individual, yet abstract enough to be homogeneously tied to physical and digital elements of the possession. This balance can be achieved through ties to the product's experiential value, such as the relaxing act of listening to music with an mp3 player, or symbolic value, such as a camera used, and resulting photos taken whilst travelling.

Physical-digital products are a diverse category of objects that is continually expanding in both form and digital functionality (Vallgårda & Redström, 2007). This diversity requires designers to adopt a flexible design approach that considers the most appropriate means for meaningful integration of physical and digital components. We conclude by providing six design themes to illustrate several ways in which designers can materialise the meaningful associations ascribed to digital contents within this diverse category of products.

**Design Theme 1: Meaningful Containers**

Many of the widely adopted physical-digital products currently available are centred on their digital functions. This was reflected in our results in which a possession was largely valued for the meaningful contents within such as photos, music or apps. There is opportunity for designers to explore the quality of *containing* as a means for materialising meaningful digital associations. We return to our example of the container-contents product system seen in a personal wardrobe. The clothes stored within a wardrobe can hold collective meanings such as an assembled outfit worn in a work environment to express professionalism or singular meanings such as a sweater received as a gift from a loved one. While it may contain meaningful contents, the wardrobe itself may be considered a meaningless storage commodity. Designers should therefore seek to create cohesive value within the entire product-system by designing *meaningful containers* that become deeply connected with their meaningful contents. The design of physical-digital products that are primarily used as containers of digital media such as external hard drives

or USB flash drives can take inspiration from the emotional value of one of their predecessors, the family photo album. As a product category, family photo albums have been known to hold significant sentimental value. The photos contained within these family photo albums may be considered precious and irreplaceable. The album itself is imbued with these attributes by serving as a protective shell, with certain material qualities such as a leather-bound exterior further reinforcing its authenticity as a container of cherished memories. Designers of physical-digital products can similarly explore the relationship between container and contents to create meaningful physical containers that are imbued with the personal meanings of their digital contents.

**Design Theme 2: Meaningful Enablers**

Digital media is often accessible across multiple devices via the usage of cloud-based storage and online streaming services. The transient nature of the digital contents accessed from a device can undermine its singularity as a meaningful container. In these cases, the primary value of the physical device is *enabling* users to view, listen, read, play, communicate, create, curate, explore, learn and reminisce. This enabling functionality allows users to engage in meaningful experiences. Devices could be designed to associate more directly with these meaningful digital experiences, for example designing an e-book reader to embody the *learning* and *self-improvement* experienced by P11 whilst reading one of her e-books. A user's collection of digital media is also continuously evolving over time, as existing media is altered, or new media is acquired. Designers seeking to materialise the meaningful associations assigned to the digital contents of a product should therefore adopt a dynamic (rather than static) approach. This can be achieved by capturing the broader significance of digital collections rather than specific temporal experiences. These broader meanings allow for evolving ties to the digital contents meaning that avoid becoming outdated over time. For example, designing a music player to associate with the *motivation* and *inspiration* that P14 experiences whilst listening to his personal music collection. These meanings are not tied to a specific digital item, but rather the continuously evolving meaning of the collection as a whole.

**Design Theme 3: Temporal Form**

A key characteristic of physical-digital products that influences their perceived unification is the *singularity* of their material form and *multiplicity* of their digital information. This

typically leads to interactive devices that make strong use of *temporal form* to move between different sensorial expressions of their contents, such as the pixels on the screen of a digital photo frame that change to display each of the contained photos. This allows the material form of a device to alternatively represent singular digital items. The temporal form of many interactive devices allows for richer experiences than static objects (Vallgårda, Winther, Mørch, & Vizer, 2015), however their universal and transient nature may hinder the process of acquiring meaningful ties to the digital items they reveal. Temporal form can be used to construct unifying links between collections of digital media, such as a digital photo frame that transitions between photos in a way that communicates a story beyond the individual captured moments. This could be in the form of a chronological retelling of a person's life or the sequencing of a particular event such as a wedding. More novel physical-digital products may utilise technologies to create three-dimensional temporal forms that unify physical and digital components. Vallgårda et al. (2015) explored the use of a shape-memory alloy and several servomotors to create boxes that transition between abstract forms in a way that evoked viewers to perceive the order of movements as telling a story. The development of such shape-changing interfaces has become an ongoing research interest within the HCI community (Rasmussen, Pedersen, Petersen, & Hornbæk, 2012).

**Design Theme 4: Physical-Digital Collections**

Materialising collections of digital media in a meaningful way could be achieved by dividing the singular device into a collection of physical objects (van den Hoven & Eggen, 2004). By dividing the materiality into a collection of objects, each object can be designed to more directly embody a specific digital collection. For example, digital photo albums could be divided and stored on a range of unique physical tokens that each relate to the event or time period at which they were taken such as unique souvenirs from various holidays. This allows the physical device to more clearly materialise specific experiences within a broader collection of personal history. Several existing research projects have explored this type of system, such as the *Chameleon Table* by van den Hoven and Eggen (2004) that allows physical souvenirs to be placed on a table to interact with digital photo albums. We discuss a number of similar systems that adopt tangible interactions to engage with digital media in the following chapter. We also further explore the merit of creating

a series of physical objects that directly relate to specific media within a digital collection through the development of a bespoke music player outlined in Chapter 6.

**Design Theme 5: Embodying Aspects of Identity**

The material properties of a device could be designed to encompass abstract, open-ended associations to the personal history and identity of the user enacted through their engagement with the digital contents. This could be achieved through data materialisation methods such as creating a patina from a cyclist's journey data (Lee, Son, & Nam, 2016) or smart textiles that contain digital story recordings (ten Bhomer, 2016). Significant aspects of a user's identity can also bring unified meaning to a physical-digital product much like P12's game console and games library similarly characterising a gamer identity. Products with more ubiquitous functions could be designed to more clearly associate with a specific aspect of the user's identity by specialising their functionality to the activities conducted in a particular role. This can be seen in BlackBerry mobile phones that are often associated with a businessperson identity as they contain work-specific features such as a full QWERTY keyboard and push email.

**Design Theme 6: Materialising Experiences**

Many digital items were considered meaningful for the experiences they enabled such as communicating, reading, listening, playing, creating, curating or reminiscing. These meaningful experiences and the emotions they conjure were less likely to be associated with the physical device. There is opportunity for designers to encourage users to associate these experiences with the physical by materialising these interaction rituals through the use of tangible (van den Hoven et al., 2007), embodied (Dourish, 2004) or hybrid (Gullick & Coulton, 2016) interactions. Examples of this include the *Materialise* kit by Golsteijn et al. (2014) and the *Marble Answering Machine* conceptualised by Bishop (1992). The *Materialise* kit contains physical, Lego-like building blocks with various interchangeable digital components such as a touch screen display or speaker that can be configured and assembled into novel forms. The *Marble Answering Machine* allows the user to grasp and place marbles as a means of interacting with their digital message inbox. Materialising experiences could also be envisioned in a music player by requiring the user to momentarily play the beat of a song as a means of selection control.

## 5.5 Conclusion

This chapter has presented a study investigating the ways in which people perceive and value their physical-digital possessions with distinctions made between physical and digital components. The self-reported associations and meaningfulness of these components were used to provide insights related to understanding the nature and source of attachment within the increasingly prevalent category of physical-digital products. The study revealed that the digital contents of these products were often the most meaningful component and that the material device was important but replaceable. These findings were used to discuss the ways in which attachment to physical-digital possessions differs to traditional material objects. Physical-digital possessions are more akin to systems of products than singular devices, causing a shift towards dematerialising and dispossessing meaning. From a sustainability perspective, there is value in creating products with meaning directly associated with their materiality to delay disposal and reduce the rate of resource consumption. It is proposed that designers can create lasting physical-digital products by adopting various methods of materialising the meaningful associations ascribed to the product's digital contents.

# 6

# DESIGNING MEANINGFUL PHYSICAL-DIGITAL OBJECTS

In Chapter 5, we identified several unique characteristics of meaningful relationships between people and their physical-digital possessions. This included the abstraction of attachment that often led to dematerialised and dispossessed forms of personal meaning. The transferable and evolving nature of personal digital media can distance its significance from association with any single device. From a sustainability perspective, there is value in creating technological products with meaning directly associated with their materiality to delay disposal and reduce the rate of resource consumption. This chapter details the design process and evaluation of *Melo*, an interactive music player intended to possess materiality that is meaningful for its user. Much like the design process detailed in Chapter 4, this was done by creating a bespoke product inspired by the intended user's personal ties to their digital music library. The findings reaffirmed the value of designing objects with meaningful associations as a strategy for promoting product attachment. Further insights were generated for materialising the meaning assigned to technological products as a means of reducing the rate of product consumption and further enabling digital collections to be used for self-extension purposes.

This chapter is based on:

Orth, D., Thurgood, C., & van den Hoven, E. (unpublished manuscript). Embodying meaningful digital media: A case study of designing for product attachment in the digital age.

## 6.1 Introduction

Physical-digital products such as laptops, smartphones, digital cameras and e-book readers hold potential for greater harmony between humans and objects through their ability to provide rich, dynamic user experiences. As more aspects of our lives move towards the digital realm, the field of product design is becoming increasingly integrated with interaction design (Vallgårda & Redström, 2007). This transition affects the ways in which we engage with products, including the development of emotional connections with our belongings. It has led researchers working at the intersection of product and interaction design to examine the personal relationships people develop with their technological devices, including the digital information stored or accessed from within. In many cases this work is done in a similar light to those looking at meaningful non-digital objects, with several directly comparing the influence of the physical or digital form on the formation of emotional significance (Atasoy & Morewedge, 2017; Golsteijn et al., 2012; Odom & Pierce, 2009; Petrelli & Whittaker, 2010). The findings of these studies suggest that people do not value their technological possessions as highly as their non-digital possessions (Golsteijn et al., 2012; Odom & Pierce, 2009; Odom et al., 2014; Petrelli & Whittaker, 2010). The role of object form on the development of product attachment to a possession has since become a key area of exploration in Human-Computer Interaction (HCI) research (Belk, 2013; Feinberg, 2013; Gegenbauer & Huang, 2012; Golsteijn et al., 2012; Kirk & Sellen, 2010; Odom et al., 2009; Turner & Turner, 2013).

The growing presence of digital components within products brings new challenges to designers seeking to promote attachment (Kirk & Sellen, 2010). Distinctions are often made between the meaning of the material device and the digital information it stores or enables. The transferable and evolving nature of personal digital media can distance its significance from association with any single device. We explore the potential for designers to create technological devices with meaningful materiality, closely integrating the physical object with the significance of digital contents.

This chapter outlines our process of applying product attachment theory to the design of *Melo*, an interactive music player inspired by a series of interviews conducted with an individual who discussed details of their life story and relationship with their

digital music library. We evaluate and reflect on our design process to discuss the effectiveness of our approach and the resulting product in promoting the formation of meaningful associations to the materiality of physical-digital objects. We conclude by exploring the applicability and limitations of our findings for promoting product attachment in the growing sector of technological devices.

## 6.2 Method

We adopted a research through design (Frayling, 1993) approach to explore the application of product attachment theory to design practices that integrate physical and digital forms. We designed, created and evaluated a bespoke music player, *Melo* containing four different artefacts that are used to select different categories of songs for playback from within a personal digital music library. In our approach, we saw merit in using in-depth research methods to explore the potential of creating technological products with meaningful materiality for their users. In doing so, we diverged from traditional product and interaction design considerations such as designing for mass production to instead focus on best practice for promoting product attachment, designing solely for the individual. We take an initial look at the potential for design practices to promote product attachment in the growing sector of technological devices. In this section, we introduce the adopted system for embodying meaningful digital media and provide an overview of the procedure we developed for the three phases of our design process. Each of the three phases involved in our process is then described in greater detail together with the resulting findings in the subsequent section.

### 6.2.1 Idea Development

We set out to explore the potential value of embodying meaningful digital media as a means of promoting product attachment to technological devices. In doing so, we considered a number of common media categories (e.g. digital collections of photos, music, e-books, videos or working files) and associated devices (e.g. digital photo frames, music players, e-book readers, media players, portable hard drives) to serve as the focus of our explorative process. We eventually settled on designing a music player that attempts to materialise the meanings assigned to a user's collection of digital music. For many years

personal music collections have played an important role in peoples identity formation processes by supporting self-reflection (DeNora, 1999; Hesmondhalgh, 2008) and reinforcing membership within different groups (Brown & Sellen, 2006; Voida, Grinter, Ducheneaut, Edwards, & Newman, 2005). The recent dematerialisation of music collections in which vinyl, cassettes and CDs are replaced with digital formats of music has been found to reduce their emotional value (McCourt, 2005; Styvén, 2010) and limit their ability to be used for self-presentation purposes (Brown & Sellen, 2006; Siddiqui & Turley, 2006). The lack of visual and tactile aspects within digital music collections provides a rich opportunity for creating a material device that extends the sensory properties and presence of the music collection within day-to-day life.

The parameters of our tangible music player were derived from the *Physical-Digital Collections* design theme formulated from the results of the study presented in Chapter 5. This design theme proposes dividing the materiality of a device into a collection of objects, allowing each object to more directly embody specific meanings that belong within a broader collection of digital media. We adopt the idea of radio-frequency identification (RFID) tagging physical objects to link them with digital information, creating a tangible interface in which these objects are used to engage with linked digital files. This type of system has been applied in a number of research projects including the *Chameleon Table* (van den Hoven & Eggen, 2004), *Memodules* (Mugellini, Rubegni, Gerardi, & Khaled, 2007) and the *Souvenirs system* (Nunes, Greenberg, & Neustaedter, 2008) that each explore linking existing physical souvenirs with digital photo albums to facilitate memory recollection and sharing practices. Similar projects have explored the merit of re-materialising digital music such as the *Tangible Music Player* (Bach, Vyrva, & Stigberg, 2015) that uses marbles to represent songs and enable multi-user interactions and *Tangible Jukebox* (Gallardo & Jordà, 2010) that uses paper cards to represent playlists and operate controls on a multi-touch surface. We diverge from these projects by giving greater attention to the materiality and significance of the physical objects themselves and their role as embodiments of the digital media they enable.

An overview of the tangible music player concept is shown in Figure 25. The idea allows music to be linked to a particular object and played by placing the object onto a central platform. This allows for the creation of a range of objects that delineate between the meanings evoked by various artists, albums, genres or songs that exist within a music

library. The use of a platform to control playback allows for attention to switch between a single object (representing a subset of music) and the collective group of objects (representing the music library in its entirety). These parameters were deemed appropriate for our design process as they allow for rich material explorations with minimal restraint on the selection of forms, textures, imagery and processes used to create each object. These parameters were deemed appropriate for our process of materialising meaningful digital associations as they allow for rich material explorations, a vital part of cueing personal meaning.

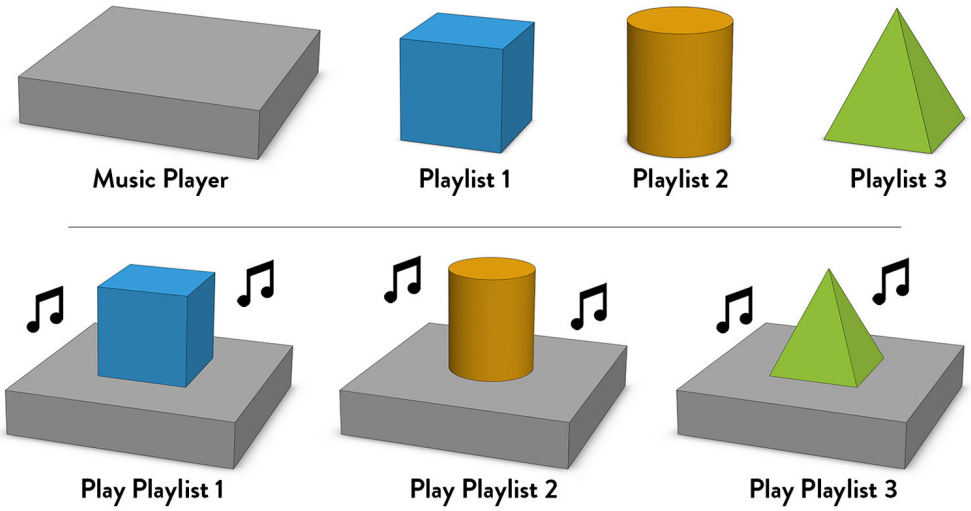


**Figure 25. Concept for interactive music player with embodiments of digital media.**

### 6.2.2 Participant

We adopted a participatory approach, working with a single participant over a six-month period to create a bespoke music player with artefacts inspired by the memories, experiences, emotions and values evoked by their digital music library. As our goal was to create a product that could embody the personal significance of digital media, we sought a participant who had a deep connection and active engagement with their digital music library. We further narrowed our search to people over the age of 45 to ensure our participant possessed a rich life history and long-term relationship with their music library. We were fortunate to recruit Andrew[2], a 54-year-old male with a lifelong appreciation for music. As reward for his involvement, Andrew was able to keep the bespoke music player.

[2] A pseudonym chosen by our participant.

### 6.2.3 Phase 1: Inspiration

Our intention of creating a bespoke music player that embodies personal meanings for its intended user demanded an empathic approach throughout the design process. To provide guidance to our design process, we conducted a series of in-depth semi-structured interviews with Andrew. Each interview contained a focal theme for questioning with subsequent interviews building upon the insights generated in prior discussions.

*Interview 1: Identity Narrative*

The first interview was carried out in a café near Andrew's workplace and lasted 1.5 hours. In this interview, we sought to reveal details of Andrew's identity narrative and individuality through discussion of his life story (Linde, 1993), much like the work of Ahuvia (2005), which investigated the life history and loved possessions of ten individuals. Interview questioning began by asking Andrew to share details of his life narrative from his childhood to current lifestyle to his aspirations for the future. This included discussion of fond memories, experiences, interests and activities throughout various life periods. We then asked Andrew to share stories of his ongoing relationship with music. This included developments in his relationship with music over time, memorable listening experiences and the role of music in relation to various aspects of his life. Andrew appeared at ease in his response to questioning—openly sharing personal stories, values and aspirations throughout the interview.

*Interview 2: Musical Experiences*

The second interview, conducted two weeks later, was carried out in Andrew's home and lasted 2 hours. In this interview, we transitioned to more directly explore Andrew's relationship with his digital music library. While Andrew also owns music in physical forms such as CDs, he accesses his music entirely through digital mediums. We began by inquiring about general associations and experiences related to his day-to-day engagements with his digital music library. To actively involve Andrew in the design process of the music embodiments, we conducted a series of probing activities within the interview to provide us with inspirational insights into his relationship with his digital music library. This began with a collaborative process of forming categories of music from within his digital library based on their relationship to different aspects of his self-identity.

We then collaboratively identified specific songs, artists, albums or genres that fit within each personal category.

We devised two types of cards (see Figure 26) to inquire about the thoughts brought to mind for each identified category of music. The first of these cards we refer to as *Music Associations* cards that asked our participant to list all associations that come to mind when engaging with a music category including memories, experiences, time periods, events, places, people, things, emotions, values, activities, personality traits or qualities. The second of these cards, we refer to as *Music Properties* cards that involve rating the properties of a music category along twelve bipolar scales related to various sensory concepts such as complexity, form, intensity, texture and weight. Each of the twelve bipolar scales were developed with the intention of aiding us in bridging the gap between the material and immaterial. We asked Andrew to complete a *Music Associations* and *Music Properties* card for each of the prior developed categories of music from within his digital library. Throughout the interview, Andrew played music from his digital library that further illustrated the thoughts and emotions that came to mind whilst listening to particular songs, artists, albums or genres.

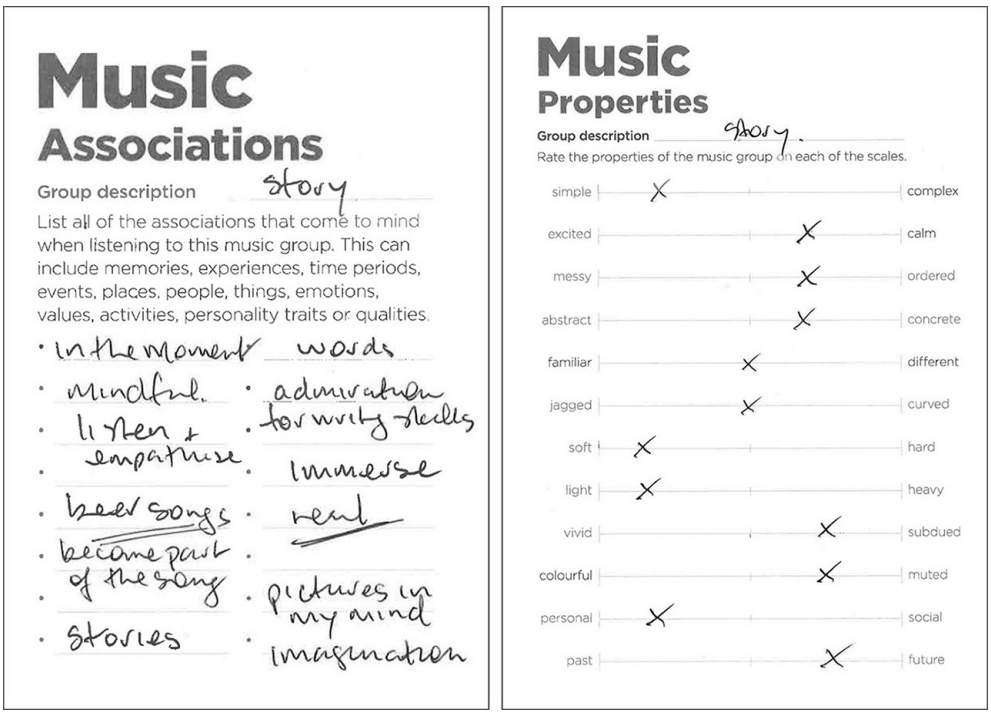


**Figure 26. A *Music Associations* card (left) and a *Music Properties* card (right).**

*Interview 3: Materialising Musical Media*

The third interview, conducted three weeks later, was carried out in a café near Andrew's workplace and lasted 30 minutes. Prior to this interview, we transcribed and analysed data from the two prior interviews and probing activities to develop visual mood boards for each of the generated personal categories of music. We presented these mood boards to Andrew within the interview session to receive feedback on whether the imagery aligned with his perceptions of each music category. This was done to ensure our understanding of Andrew's relationship with his digital music library aligned with his own self-views. We also provided Andrew with an overview of the intended music player system and its components to openly discuss ideas for suitable imagery and interactions for each physical component.

### 6.2.4 Phase 2: Creation

We used the stories and insights shared by our participant as inspiration for the design of several embodiments of his music collection. We aimed to translate elements of the user's life narrative that are reflected by their digital music library to the physical design of a music player. This translation was intended to facilitate the formation of emotional value in the music player through its ability to characterise and communicate the significant memories, experiences and values evoked by the user's digital music library.

To inform our design process, we conducted an analysis of the three interview sessions and probing activity responses. Each interview was transcribed with excerpt data coded for its links to aspects of Andrew's sense of self or music from within his digital library. This process provided inspirational data in the form of coded interview excerpts, listed associations, property ratings and evaluated mood board imagery that provide an overview of each category of music. Design concepts for the music player artefacts were judged by the authors for the significance, clarity, relevance and quantity of personal associations that they aim to embody. All components of the music player were created by the named author, an industrial designer with several years of industry experience. The ideation process was conducted in a similar manner to traditional design practice with a range of sketched concepts and paper prototypes explored prior to the creation of the final media embodiments and music player platform.

### 6.2.5 Phase 3: Evaluation

We concluded our process by evaluating the effectiveness of our designed music player system in developing meaningful associations that reflect the significance of the user's personal music library. Our participant Andrew was given the music player to incorporate within his day-to-day listening practices at home over a five-week period. At the conclusion of this period, we conducted a final interview to discuss his experiences with the music player. This involved the completion of an *Object Associations* card (see Figure 27) for each of the media embodiments used to control playback selection. Much like the *Music Associations* cards completed for each music category, *Object Associations* cards asked our participant to list all associations that came to mind when engaging with an artefact within the music player system. We also asked Andrew to compare the meaningfulness and authenticity of each object in embodying the personal significance ascribed to the digital music they contained. We concluded the interview by reflecting on Andrew's involvement throughout the research project. This evaluative interview was transcribed and analysed thematically (Braun & Clarke, 2006) alongside reflections on the design process to determine the effectiveness of our approach in meaningfully integrating physical and digital components within a technological product.

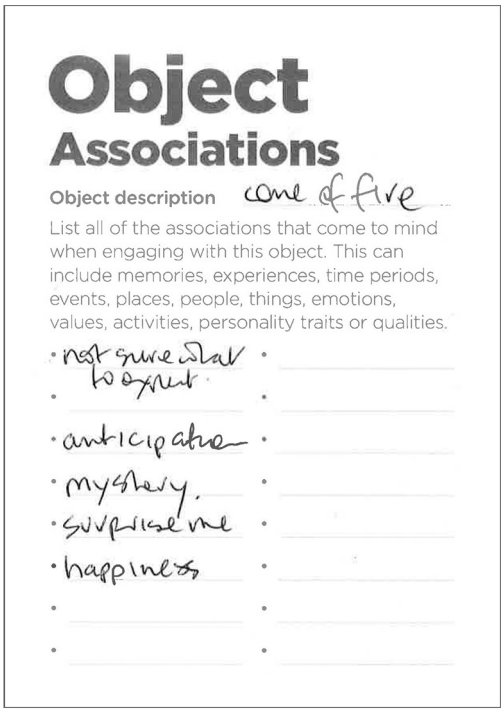


**Figure 27. An *Object Associations* card.**

## 6.3 Design Process and Findings

We present our findings within the three phases of the devised design process: inspiration, creation and evaluation.

### 6.3.1 Phase 1: Inspiration

In this section, we provide a brief overview of Andrew's life narrative re-presented in the interview sessions, his relationship with music and the results of our probing activities, culminating in the development of four identity-based personal music categories extracted from his digital library.

*Andrew's Life Narrative*

Andrew is a 54-year-old father with a career in IT sales and client management. He grew up and continues to live near the northern beaches of Sydney. Throughout his life, Andrew has enjoyed staying active, being outdoors and attending local live music events. More recently, Andrew has picked up learning to play the bass. Some of his most cherished possessions include his collection of music posters from various live performances (see Figure 28), his bass guitar and several books on rock music posters. In the near future, Andrew looks forward to retirement, freeing time for travelling and continuing to learn to play the bass.


**Figure 28. A music poster from Andrew's cherished collection.**

### *Music Categories*

As part of our design process, we worked collaboratively with Andrew to develop a number of identity-based categories of music from within his digital music library. We used post-it notes to generate four distinct categories of music with which he has a rich relationship (see Figure 29). This was done to create divisions in the diversity of his digital music library in relation to the varying ways in which they relate to him personally. Music grouped under a particular category could relate to a particular artist, album or song from his library.

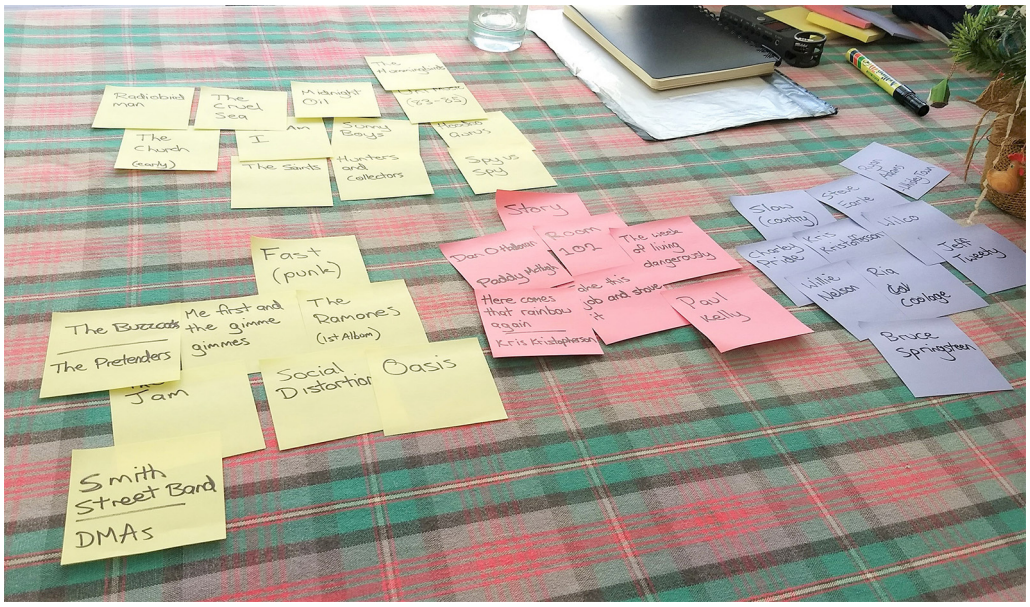


**Figure 29. Developing identity-based music categories from Andrew's music library.**

**Youth**

The first of the identity-based music categories was referred to simply as *Youth*, relating to music from Andrew's late teens and early 20's, coinciding with his time attending university. His appreciation for music grew rapidly during this period. Andrew credits this to his younger brother and friends playing in local bands and the vibrant local music scene across Sydney at the time. During this time, attending live music became a central part of Andrew's social life: *"weekends got pretty much consumed by music"*. In addition to his social experiences, Andrew vividly recalls the abundance of artistic music posters wrapped around telegraph poles to advertise upcoming events that have become strongly associated to this category of music. In response to the stories, self-reported associations and properties characterised by this category of music, we created a visual mood board (see Figure 30) to further collaborate with Andrew in our attempt to create a meaningful material representation.

**Music Associations:** university, friends, fun, going out, growing up, getting drunk, [local venues], being young, fast, energy, lively, being 'alive', youth

**Music Properties:** simple, excited, messy, familiar, hard, heavy, vivid, colourful, personal, past

**Example Artists**: Sunnyboys, The Saints, Hoodoo Gurus, Midnight Oil, You Am I

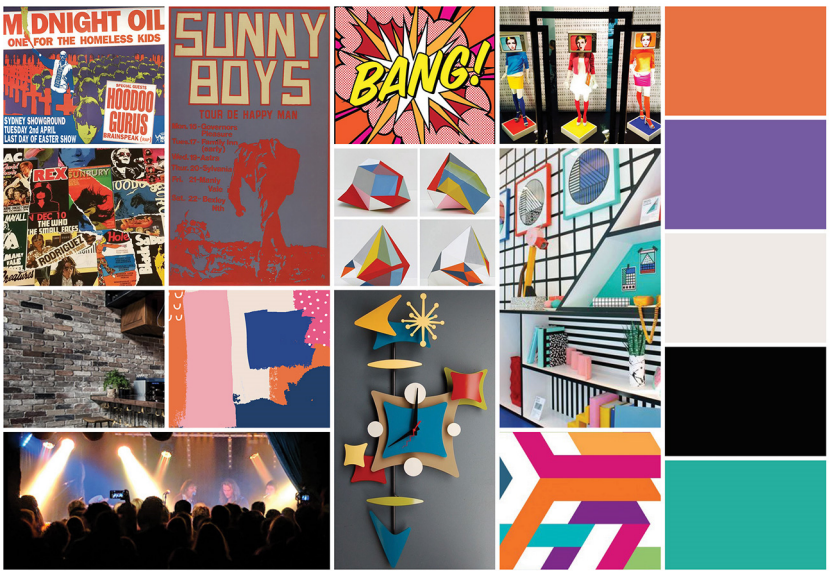


**Figure 30. Mood board inspired by Andrew's *Youth* music.**

**Story**

The second of the identity-based music categories was referred to as S*tory*, relating to songs within Andrew's music library that contain lyrics that tell vivid stories. In contrast to the previous *Youth* category of music that contains personal associations to a specific time period, Andrew's relationship with music within the S*tory* category is much more experiential. These songs create a uniquely immersive and vivid experience for Andrew as a listener: *"I've just listened to a two-minute song and it's like I've watched a movie"*. We listened to many of the songs reported by Andrew to further aid our process of translating these immersive narrative experiences into material and visual qualities (see Figure 31).

**Music Associations:** in the moment, mindful, listen and empathise, beer songs, become part of the song, stories, words, admiration for writing skills, immerse, real, pictures in my mind, imagination

**Music Properties:** simple, calm, ordered, concrete, soft, light, subdued, muted, personal, future

**Example Artists**: Paul Kelly, Jason Isbell, Steve Earle, Paddy McHugh

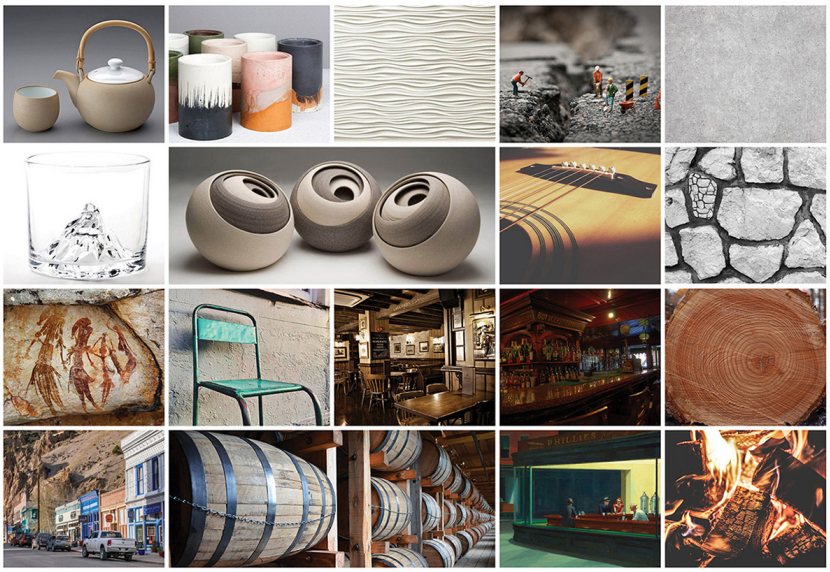

**Figure 31. Mood board inspired by Andrew's *Story* music.**

**Slow**

The third personally significant category of music from Andrew's digital music library, referred to as S*low* relates to simple acoustic songs. Throughout Andrew's childhood, his family would take long road trips to visit relatives. During these road trips, his father would play country music through the car's speakers. While he had little interest in this music at the time, Andrew has since developed an appreciation for many of these songs. While listening to this music many years later, Andrew associates its simplicity to his younger self and the slower country lifestyle adopted on family trips away from the city. In reviewing our mood board for this music (see Figure 32), Andrew emphasised a focus on imagery relating to the country musician rather than rural landscape.

**Music Associations:** being a kid, real stories, simple music, mum and dad, relaxing, introspective, Fiat, road trips, wilderness, getting away from day-to-day, romantic, real, from the heart, Nashville

**Music Properties:** simple, calm, ordered, concrete, familiar, curved, soft, light, subdued, muted, personal, past

**Example Artists**: Charley Pride, Dolly Parton, Kris Kristofferson, Jeff Tweedy, Willie Nelson

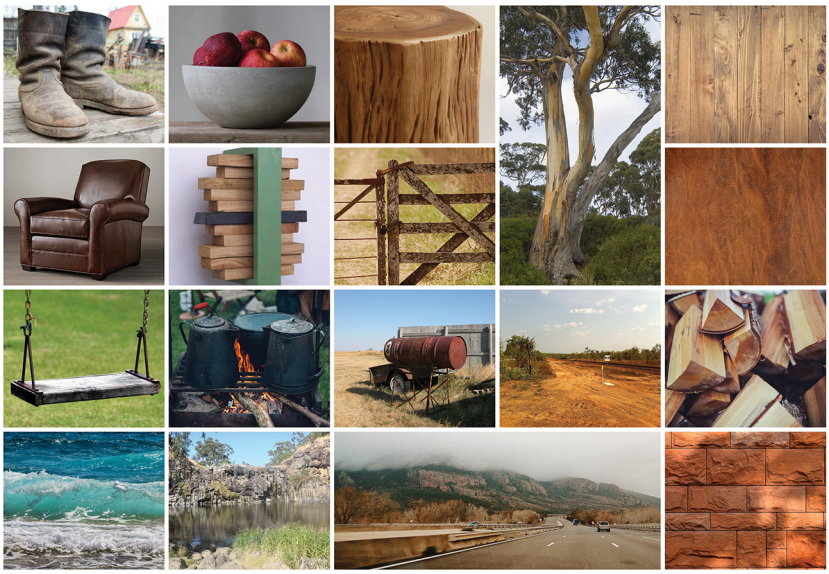

**Figure 32. Mood board inspired by Andrew's *Slow* music.**

**Fast**

The final category of music highlighted in our collaborative design process was referred to as *Fast*, relating to the brash style of punk music from Andrew's library. Much like the *Story* category of songs, this music is predominantly valued experientially as refreshingly one-dimensional. Andrew described this category of music in relation to his experiences while growing up, discovering many of his favourite punk-rock bands in the transition to adulthood. Andrew's feedback to our mood board (see Figure 33) emphasised the attitude intrinsic to the *Fast* category of music: *"it's just not serious, it's short, it's disposable, it's loud, it's funny..."*

**Music Associations:** energetic, fast, aggressive, loud, brash, show-off, growing up, simple

**Music Properties:** simple, excited, messy, concrete, familiar, jagged, hard, heavy, vivid, colourful, present

**Example Artists**: Ramones, The Buzzcocks, The Jam, Social Distortion

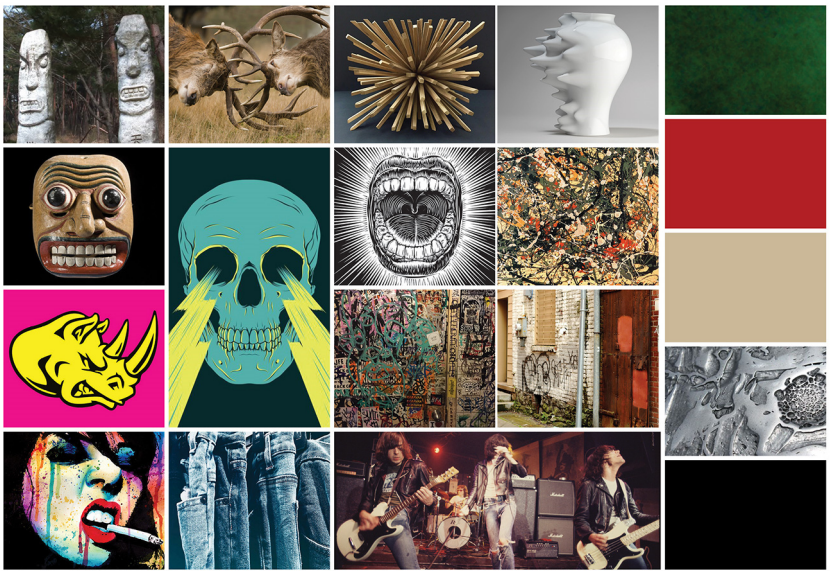

**Figure 33. Mood board inspired by Andrew's *Fast* music.**

### 6.3.2 Phase 2: Creation

This section details the inspiration and design decisions that culminated in the creation of *Melo*, a bespoke music player containing five artefacts that collectively embody the personal significance of our participant's relationship with his music library (see Figure 34).

*Melo: A Bespoke Music Player*

Our design process resulted in the construction of a bespoke music player designed to possess meaningful materiality that integrates with the personal significance of the music it plays. It consists of a central platform and four unique objects that were inspired by Andrew's relationship with music from within his digital library. By placing one of the objects onto the central platform, *Melo* will begin to play songs from the correlated music category in random order. If the object sitting on the central platform is swapped with a different one, it will then play songs from the new object's music category. To stop playing songs, the object can be tapped onto the central platform a second time.


**Figure 34. Melo: A bespoke music player.**

### *Plast: An Object Embodying Andrew's Youth Music*

Andrew's personal associations to the *Youth* category of music were predominantly based on memories from his late teens and early 20's. His vivid descriptions of the graphic music posters frequently seen throughout his youth led us to explore ways to recreate their vibrant features and distinctive style. This process resulted in *Plast* (see Figure 35), a hand-crafted object made from casted plaster and finished with gouache paints. We drew inspiration for the painted finish from an analysis of our probing activities, mood board feedback and examining a range of music posters from the early 1980's that reflected Andrew's descriptions. The design uses segmented block colours and bold, stencil text that depicts typical event details such as the performance date. All details were hand-painted, creating an imperfect brushstroke texture that echoes the unrefined style of posters. Gouache paint was chosen for its vibrant, matte finish.


**Figure 35. Plast: An object embodying Andrew's *Youth* music.**

### *Ember: An Object Embodying Andrew's Story Music*

Andrew's *Story* category contains music with lyrics that create immersive narratives. Listening to these songs brought to mind vivid imagery for Andrew of *"like-minded people sitting down and sharing stories"*. In response to our mood board, Andrew was drawn to images of wooden bar interiors, acoustic guitars and a warming fire. In our process, we sought ways of using the imagery of a campfire to bring about links between the physical object and the listening experience, resulting in *Ember* (see Figure 36). We hand-turned a wooden cone to soften and condense the imagery of a campfire into a single form. Imagery of flames and smoke were added to the surface of the cone using a colour-wash technique, allowing the natural grain of the wood to remain visible.

**Figure 36. Ember: An object embodying Andrew's *Story* music.**

### *Hide: An Object Embodying Andrew's Slow Music*

Andrew's rich childhood recollections of long family road trips with his father's country music playing through the car speakers led us to explore imagery of simple details of rural landscapes with an emphasis on rich textures and colours. Andrew's collection of *Slow* music was found to evoke imagery of the country musician and rural lifestyle. This imagery was used in the design process of *Hide* (see Figure 37), an object made from vegetable-tanned leather with imprinted patterns. In the design process of *Hide*, we drew upon imagery of iconic western leather cowboy boots, including pull tabs, raised sides and ornate patterns. We opted to create a single, cylindrical form to reflect Andrew's appreciation for the simplicity of the music. Imprint details were used to provide subtle tactility to the object whilst being handled.

**Figure 37. Hide: An object embodying Andrew's *Slow* music.**

### *Joey: An Object Embodying Andrew's Fast Music*

Andrew's punk-rock centric *Fast* category of music reflected an ongoing part of his identity that spans back to his formative years of early adulthood and was likened to *"the image of a punk sort of character"*. This input was used to inspire our process of creating *Joey*, a character-like object made from porcelain and finished with a matte black glaze (see Figure 38). We drew upon the appearances of musicians featured in the *Fast* category of music to create a character-like porcelain sculpture. Certain facial features adopted a simplified cartoon-type styling to emphasise the playful, tongue-in-cheek nature of the depicted character. A matte black glaze was used to echo the smooth texture of the black leather jackets commonly worn by the featured musicians.

**Figure 38. Joey: An object embodying Andrew's *Fast* music.**

*Technical Details of Melo*

The central platform was constructed from a 3D printed nylon base and laser cut blue gum veneer lid. This housed a Raspberry Pi 3 computer connected to a HiFi sound card and RFID card reader (see Figure 39). Unique RFID tags were attached to the base of each of the four objects. The Raspberry Pi 3 computer powered the software written in Python to detect when a RFID tag was placed in close proximity to the RFID card reader and to either play or stop playing songs from a specific digital music folder correlating to each of the unique tags. An external USB cable and 3.5mm auxiliary audio cable were used to power the device and connect to household speakers.

**Figure 39. Technical components of *Melo*: A Raspberry Pi 3, RFID reader and sound card.**

### 6.3.3 Phase 3: Evaluation

In this section, we discuss the results of our deployment of *Melo* with Andrew over a five-week period. During deployment, *Melo* was set up in Andrew's lounge room, connecting to his existing home theatre speakers from which he would ordinarily play music via his smartphone. Andrew opted to use *Melo* exclusively when listening to music at home throughout the deployment period. He would most often use *Melo* to unwind after returning home on a Friday or Saturday night, typically whilst sitting on the couch having

something to eat or watching sport (muted) on television. These listening experiences were primarily while Andrew was at home alone.

Andrew's experiences of using *Melo* to listen to his digital music were overall positive. The limited functionality of *Melo*, only allowing for selection between four categories of music rather than individual songs was highly valued, providing Andrew with a greater sense of appreciation throughout his listening experiences: *"the player allowed me to […] sit down and appreciate [the music] rather than judge it and change it"*. These interactive properties had a strong effect on Andrew's listening habits. Selection between the four categories of music and associated objects was heavily mood-driven with extended periods of listening often transitioning from one of the more upbeat categories to a more mellow category or vice versa. Rather than actively monitoring and selecting songs for playback, Andrew would freely listen to music from one of the objects for hours at a time before switching to another music category. This change to his listening habits helped Andrew *"relax a bit more"* during his time spent unwinding in the evenings. Andrew also appreciated the inherent element of surprise involved in the random selection of songs from within a certain music category. This element of surprise was further emphasised in the early stages of use during which the specific songs associated with each object were still being discovered. Andrew recalled several occasions in which *Melo* played a lesser-known song from his collection, leading him to slowly rediscover the song's title, artist or album by carefully listening to its intro, melody, riff, lyrics or chorus.

### *Object Associations*

Each of the four objects used to control *Melo* were evaluated for the associations they brought to mind, their mental connection to the music they embodied and their proximity to Andrew's sense of self. These evaluations were primarily comparative between the four different playback objects.

*Plast*, the hand-crafted object finished with vibrant gouache paints was perceived to contain a clear link with the music it embodied and enabled when placed on the central platform. It had "*blindingly obvious*" associations with the upbeat, lively music from Andrew's youth. The form of *Plast* was associated with *beer* from our intended reference to the live music events hosted in local pubs and bars that Andrew fondly recalled. Andrew did not form associations relating to his appreciation for the graphic music

posters that advertised these events, instead seeing parallels in the colours to the visual style of pop art.

*Ember*, the hand-turned wooden cone finished with colour-washed imagery of flames and smoke was the least effective of the four objects in providing a clear association to the music it embodied. Throughout the deployment period, Andrew did not form a clear connection between *Ember* and the *Story* songs it would play, leading it to be perceived as *mysterious*. By the end of the deployment period, Andrew began to associate *Ember* with *"stories around the fire"* however it did not elicit the experiential associations of the immersive music itself.

Andrew perceived *Hide*, the object made from vegetable-tanned leather with imprinted patterns, to contain the most obvious association to the music it embodied. The use of leather elicited strong *country* and *western* associations that plainly reflected the *Slow* music category.

*Joey*, the character-like object made from porcelain was initially likened to a *tiki mug* (a sculptural ceramic mug). Much like *Ember*, this raised uncertainty for Andrew when using *Joey* to select music for playback. Over time and through closer inspection of the object, Andrew came to closely associate *Joey* with a member of the American punk-rock band, Ramones.

There were clear differences in Andrew's perception of each object relative to its proximity to his own sense of self. Both *Plast* and *Joey* were strongly associated with Andrew's self-identity, while *Ember* and *Hide* were less effective in doing so. This appraisal did not relate to the clarity of association between the object imagery and the personal category of music it embodied, but rather the materiality of the object in and of itself. The *pop art feel* of *Plast* and *cartoony, bubblegum punk* styling of *Joey* both reflected visual styles that Andrew closely identified with. In contrast to this, Andrew did not personally identify with the materials and imagery used in *Hide* and *Ember,* respectively. Differences in Andrew's affinity with each object reflect the issue of *authenticity* addressed in Chapter 4. The closeness of an object to Andrew's personal affiliations with certain visual and aesthetic properties either contributes to or detracts from its perception as an *authentic embodiment* of an associated aspect of his sense of self.

In several instances, we were successful in creating intentional associations between an object and imagery related to the personal memories and experiences evoked by

Andrew's music collection. While it is clear that our design decisions influenced the associations evoked by each of the four objects, we are reluctant to make overt claims that these decisions brought greater personal significance to the device itself. Each of the objects served functional purposes as a means of controlling the playback of Andrew's meaningful music collection. These interactions facilitate the process of forming factual connections between the objects and the music, irrespective of their material properties. Regardless, the specific associations evoked by our objects suggest that material design decisions made by designers are able to enrich ties between the physical and digital properties of technological products.

### *Object Meaningfulness and the Self*

In our evaluation of the meaning assigned to each of the physical objects involved in the design of *Melo*, we found the associations ascribed to the device to stem from not only the digital music we aimed to embody, but also our user's pre-constructed understandings of product properties such as form, colour, texture, size and weight. Andrew's strong connection to the pop-art styling adopted in *Plast* and character-like styling adopted in *Joey* emphasised their relevance to his own sense of self. In contrast to this, the leather finish of *Hide* distanced the object from Andrew's sense of self and diminished its meaning, despite its strong association to the personally significant S*low* music category. This reflects the need for a broader consideration of the ways in which people respond to and associate with the complex combination of properties involved in the materiality of the products they own.

The material forms of popular technological devices such as phones, tablets and digital cameras are often universal, devoid of qualities that reflect the diversity or specificity of the digital experiences they enable. It is often difficult to define and segregate personas and identity roles through the use and ownership of possessions in digital contexts (Belk, 2013). Technological products may more effectively acquire associative meaning by specialising or demarcating their material and functional qualities to the practices conducted in a particular identity role. In the construction of our bespoke music player, we divided the digital music library into distinct categories, each with separate corresponding objects that relate to various aspects of the user's identity. While *Melo* is a single product, we believed it was essential to create multiple objects to reflect the diversity

and depth of the significance of Andrew's relationship with his digital music library. There was a need for us to balance the specificity and universality of the device's materiality to reflect the divergent and shared qualities of the digital contents. Existing processes of managing digital media often store meaningful and meaningless items together, muddling their value (Whittaker, 2011). Establishing systems that allow for greater distinctions between conceptually unified collections stored within physical devices may enable digital collections to more effectively enable self-extension processes.

The relative meaningfulness of each of the four embodiments were not easy for Andrew to distinguish in relation to one another. Much like the music collection, the objects blurred boundaries between singular and collective value. The meaningfulness and associations ascribed to the designed objects often related to the music player *Melo* in its entirety, associating the listening experience with *happiness*, *relaxation* and *appreciation of music*. While we designed several unique objects from distinct categories of music, the overall design of *Melo* was informed by a common thread in Andrew's appreciation for simplicity, honesty, realness and emotion that is central to the significance of both his music collection and sense of self.

Beyond our focus on materiality, the limited control that *Melo* provided over the selection of songs for playback was seen to contribute to its significance by providing a sense of anticipation: *"[it was] not knowing what was going to happen but knowing that I would enjoy it when it did."* Andrew likened using *Melo* to the experience of going to a band's live show: *"you've got no control over what they're going to play and in what order […] it was nice committing to that and then enjoying the experience."* This suggests that physical and digital meanings may also be further integrated by designing physical interactions that enrich the experiential qualities of a user's engagements with their digital media.

### *Meaningful Digital Media*

The digital music library analysed and incorporated within our design process possessed a rich personal history with Andrew that spanned the majority of his life. He appreciated both slow and fast, quiet and loud, lyrical and melodic styles of music that could not be fully addressed from following summative methods of data collection (Golsteijn & Wright, 2013). Andrew's emotional connection to songs within his library predated their existence as digital media, previously being accessed via cassettes, vinyl records, radio,

television or live performances. While music has a history beyond digital media that ties it to other material or visual forms, past studies have shown that people also form deep emotional connections to digital possessions with no prior material existence such as personal data from video games (Watkins & Molesworth, 2012), apps (Denegri-Knott et al., 2012) and text messages (Odom et al., 2011).

## 6.4 Discussion

We set out to explore ways in which design can support the development of meaningful ties between users and the materiality of physical-digital objects. In doing so, we entered a dialogue with our participant in which they provided inspiration for and responses to a bespoke music player intended to reflect the personal significance associated with their personal library of digital music. Andrew's experience while engaging with our research product, *Melo* highlights the various ways in which people evaluate objects through their inferred associations.

### 6.4.1 Opportunities and Considerations in Designing Meaningful Materiality

Our process of associating the materiality of a physical-digital product with its digital contents contains several promising aspects for promoting product attachment in the technological sector. Firstly, by creating associations to an ever-changing collection of personal digital media rather than a static source of meaning such as a memorable past experience. In this way, the materiality of the product is able to remain relevant to the user's present sense of self as the digital collection itself changes over time with the addition or removal of media. This allows for long-lasting attachment to develop, addressing sustainability concerns such as the rate of product consumption (Huang & Truong, 2008), a primary objective for many of the studies exploring this area of design (Chapman, 2014b; Gegenbauer & Huang, 2012; Odom & Pierce, 2009; Odom et al., 2009). Secondly, by utilising meaningful memories and associations within the design process as a method of promoting strong emotional bonds between users and products. Memories and associations are often argued to provide greater degrees of attachment than other identified determinants of product attachment (Niinimäki & Koskinen, 2011; Page, 2014; Schifferstein & Zwartkruis-Pelgrim, 2008).

Designing for product attachment within the growing sector of technological products poses a unique issue in which the meaning assigned to a product may not be tied to the object itself but rather its digital functionality or contents (Meschtscherjakov et al., 2014; Vincent, 2006). This issue remains largely unaddressed in the design strategies proposed in past studies of attachment to physical objects. Our focus on integrating the physical and digital components of a technological product increases the likelihood that the personal meaning assigned to a product is tied to its materiality, a key distinction for strategies intending to reduce the rate of product consumption (Mugge, Schoormans, et al., 2005; Orth, Thurgood, & van den Hoven, 2019).

While our process was effective in many ways, there are also several limitations to its application in design practice. To elicit a desired associative response, designers are faced with the difficult task of anticipating another person's reaction to the products they create. Our music player was also designed for a single individual with inspiration derived from their unique life stories, an approach that is often not possible in traditional design practices. This limitation is partly inherent to the ways in which people form attachments to their belongings. Previous studies have highlighted that the experience of attachment is unique to the individual (Niinimäki & Koskinen, 2011) and that it is not possible for one design to have emotional value for all intended users (Desmet et al., 2001).

We see potential for utilising our process of materialising the meaningful associations ascribed to digital media in several emerging areas of practice, in particular the design of personal devices that contain curated or created media. Advancements in custom manufacturing technology such as additive manufacturing provide growing opportunities for bespoke material design practices such as those presented in this chapter as an alternative to traditional mass production processes. Similarly, technological advancements in the material forms of electronic components expand the possibilities of integrating digital information and interactions within traditionally non-digital forms.

### 6.4.2 Embodying Meaningful Digital Media

The material properties of the objects designed as part of *Melo* were an integral part of our attempt to materialise meaning. Our process of selecting materials, colours, forms, textures and imagery was heavily inspired by the interviews and probing activities conducted with our participant. While music is entirely immaterial, Andrew was able to

clearly describe material and visual properties that came to mind in association with each of the four personal categories of music. We see this to reflect the *remembering-imagining system* presented by Conway and Loveday (2015) that details how people use their imagination when remembering and use their memories when imagining. Andrew vividly associated his *Fast* music with imagery of a punk-type character, his *Slow* music with the outfits of western cowboys and his *Story* music with people sitting down and sharing stories, despite having no autobiographical memories of specific events in which this imagery was encountered. These depictions may best be described as imagined concepts that encompass the moods, emotions and feelings experienced by Andrew while listening to the music. The imagined properties tied to Andrew's digital music provided rich, detailed data to guide the development of physical designs that accurately represented the meaningful media. The ease of which Andrew was able to construct vivid imagery that encompassed each of his personal categories of music suggests that personal collections of digital media are able to be conceptualised in material terms, providing vast opportunities for designers to create closer connections between the physical world and the digital world.

Several projects have adopted creative methods of materialising digital media, such as Brooklyn-based design studio REIFY's use of audio data from songs to create abstract 3D-printed sculptures or *Trace-Marker* (Lee et al., 2016), a system for engraving visualisations of cyclists' journey data onto bags. While these examples are effective in bridging the gap between physical and digital properties, they do not attempt to distinguish between significant and insignificant properties of the digital media or the mental model of the individual user to direct the development of meaningful material forms. To materialise the meaning assigned to digital media, we argue in favour of designing devices to embody the personal, rather than generic, qualities of the media.

Our process involved identifying the personal meaning associated with a user's digital media and using this knowledge to design the physical device in such a way as to embody this meaning. This was intended to more deeply integrate physical and digital meanings of the device and required careful consideration of the intended user's relationship with their digital media and the ways in which material properties may reinforce or enhance this relationship. Manipulating the material properties of a product in such a way as to elicit a desired associative response has long been used by designers as

a strategy for influencing user perceptions (Crilly et al., 2009). Norman (1988) illustrates how eliciting an associative response is used to improve the usability of products by using the example of door designs that provide signals to the user on whether they should be pushed or pulled to open. Our process instead aims to enable designers to use this approach to elicit an associative response that is personally meaningful for the user, requiring a deep understanding of their individual values, experiences and perceptions of the material world.

## 6.5 Conclusion

Despite their prevalence and significance in people's lives, technological devices are often perceived to be highly replaceable. From a sustainability perspective, there is value in creating technological products with meaning directly associated with their materiality to delay disposal and reduce the rate of resource consumption. We set out to explore the potential for design to promote the formation of product attachment by creating technological devices with meaningful materiality, closely integrating the physical form with the significance of its digital contents. We used the life stories and ongoing input of our intended user as inspiration for the creation of *Melo*, a bespoke music player. Our evaluation and critical reflection of our design process and resulting design highlight various factors for designers to consider in creating devices that hold meaning within their material forms. Designing the material and interactive properties of a device to embody the meaningful associations ascribed to digital media holds potential as a strategy for promoting product attachment within the growing sector of technological products. Embodying the meaning assigned to digital collections also provides an opportunity for extending and enriching their personal significance and role in identity formation processes. We intend for the process and resulting design presented in this chapter to inspire designers to further explore the value of materialising meaning in their practice to enrich user-product relationships with both physical devices and collections of digital media.

# 7

# DISCUSSION

This thesis investigates the ways in which designers can promote the development of product attachment through their practice. Existing product attachment research has predominantly focused on understanding why and how people come to cherish their belongings (e.g., Csikszentmihalyi & Rochberg-Halton, 1981; Kleine & Baker, 2004; Mugge, Schifferstein, et al., 2005a; Niinimäki & Koskinen, 2011; Page, 2014; Schifferstein & Zwartkruis-Pelgrim, 2008; Schultz et al., 1989). More recently, this has included digital belongings and the proposal of design strategies for promoting product attachment (e.g., Denegri-Knott et al., 2012; Golsteijn et al., 2012; Kirk & Sellen, 2010; Mugge et al., 2008; Odom et al., 2009; Petrelli & Whittaker, 2010; Zimmerman, 2009). Recent technological advancements have led the field of product design to become increasingly integrated with interaction design (Vallgårda & Redström, 2007). This research project provides insights related to understanding the implications of technological changes on the development of product attachment and in applying insights from product attachment theory to design practice.

In this chapter, we begin by summarising the key contributions of the thesis. Subsequently, we discuss the nature of product attachment and meaningfulness in the context of technological products. We then discuss our evaluated design strategy for promoting attachment in physical and physical-digital products. In addition, we reflect on the novel probing methods detailed in Chapters 3–6 and the material outcomes of our design processes reported in Chapters 4 and 6. We conclude by providing design

considerations for designing meaningful objects and suggest a number of directions for future research.

## 7.1 Summary of Key Contributions

To explore the potential for design practice to promote the formation of product attachment, a probing study detailed in Chapter 3 revealed the breadth and prevalence of meaningful associations tied to participants' own cherished possessions. These associations were self-reported as meaningful by participants for their relation to various facets of their self-identity. Unexpectedly, newly introduced products were rated highly in terms of meaningfulness and 'me-ness' when they evoked personal associations, suggesting potential value for application within design practice.

A strategy for utilising meaningful associations within a design process was developed, implemented and evaluated in a subsequent study detailed in Chapter 4. This strategy involved a process of designing objects with material or interactive properties that mentally pair with concepts that have been identified as meaningful to the intended user. In implementing and evaluating our strategy, we were successful in creating intentional associations between an object and a personal idea, memory or experience with evidence indicating this brought meaning to the designed object in several instances. Findings from our evaluation suggested two conditions that promote designing objects with meaningful associations. First, the target of association for the object must be a significant source of meaning for the intended user. Second, the object must be perceived as an authentic embodiment of the target source of meaning. An example of both these conditions being met was found in the design of *Diramu*, a candle cover detailed in Chapter 4. The object was associated with the intended user's personal experiences of Australian bushfires, a source of powerful emotions and memories. The familiarity of the candle's scent, the flickering flame and the evening silhouette of eucalyptus trees led the object to be perceived by the intended user as a genuine representation of their personal experiences.

Technological products are becoming increasingly prevalent in people's lives, yet several studies have found that they are less likely to acquire emotional significance for their users than physical products (Golsteijn et al., 2012; Odom et al., 2014; Petrelli & Whittaker, 2010). An overview of the unique characteristics of product attachment in the

context of physical-digital products was developed from the results of a probing study detailed in Chapter 5. Our findings revealed that the digital contents of these products were often the primary source of meaning as opposed to the physical object. Physical-digital products were often perceived as systems of products rather than singular devices, leading to dematerialised and dispossessed forms of attachment.

Our strategy for utilising meaningful associations within a design process was adapted for physical-digital products, implemented and re-evaluated in a study detailed in Chapter 6. Critical reflections on the process and resulting design reaffirmed the strategy's potential for promoting the formation of product attachment in design practice. Further insights were generated in relation to embodying meaningful digital media and appropriately handling the user's summative evaluation of material and interactive properties.

The collective findings of the four aforementioned studies provide further contributions in the form of a design process for promoting product attachment, reflections on our adaptation of probe methodology, the creation of several highly resolved inspirational research products (Odom et al., 2016) and considerations for designing meaningful objects detailed in the later sections of this chapter.

## 7.2 The Divide Between Physical and Digital Meaning

Distinctions between physical and digital artefacts have pervaded discussions in the HCI community for the past four decades (e.g., Borgmann, 1984; Dourish, 2004; Fitzmaurice, 1996; Odom et al., 2014; Petrelli & Whittaker, 2010). Throughout this period, digital technologies have become increasingly prevalent in people's lives, continually bringing new opportunities and challenges for integrating the physical and digital world. Researchers concerned with philosophical implications of digital technologies have criticised the dematerialisation of artefact-based functions as a loss of experience. Borgmann (1984) argues this loss of experience to stem from the concealed performance of digital technology. Users of technological devices only engage with and experience the foreground of the experience, for example, the animated screen of a phone without perceiving the underlying componentry of processors, circuit boards and sensors that

enable these experiences. Similar criticisms have been made towards prevalent forms of technological products for not sufficiently acknowledging the significance of the materiality of these products in our everyday sense making (Dourish, 2004; Ehn & Linde, 2004). While these arguments suggest that digital technologies *diminish* the meaning-making processes that occur through our relationships with objects, other researchers provide a more optimistic stance on the role of digital artefacts. These studies have found digital possessions such as photos or videos to be valued in similar ways to their material counterpart, allowing us to express individuality (Bryant & Akerman, 2009), reflect our social ties (Martin, 2008), connect us to our past (Kirk & Sellen, 2010) and remind us of loved ones (Watkins & Molesworth, 2012). Our own experiences of discussing the meanings of physical and digital possession with participants as part of this thesis have provided instances of digital technologies both positively and negatively impacting the personal significance of a possession. We avoid debating whether or not digital technologies diminish or enhance meaning-making processes and instead focus on the impact of digital technologies on the *assignment* of meaning to a particular object.

### 7.2.1 Descriptive Overview

Imagine you have just returned from an overseas holiday to a country you've always dreamed of visiting. On this trip you had a number of memorable experiences with the people, sights, sounds, and tastes you encountered. Among other belongings, you carried a digital camera, capturing photos of memorable moments along the way. In what ways would this digital camera come to be associated with the significance of the holiday? Would the camera, digital photos or both the camera and the resulting photos be linked with the memorable moments captured? If the camera was deemed meaningful, at what level of abstraction would this meaning be ascribed? Would it be the specific camera carried and used throughout the trip, the brand of the camera for its high-quality lenses or the functionality of digital cameras in general, enabling the capture of visual scenes? If the digital photos were deemed meaningful, how would this meaning be ascribed? Would it be a particular photo or photos that capture the most significant moment/s or the collection of photos as a whole, summarising memorable experiences from the entire holiday? Going further, would the meaning assigned to the photo apply only to a specific

JPEG file, to any saved digital copy, or to the copy that was printed out, framed and displayed in the home?

| Physical Device (e.g. camera) | Digital Information (e.g. photos) |
|---|---|
| The camera that was used | The specific JPEG image file |
| The specific camera model | Any copy of a digital photo |
| The brand of cameras | The collection of digital photos |
| Cameras in general | Digital photos in general |

**Table 6. Levels of abstraction in physical-digital products.**

The above example and summary table (see Table 6) illustrate the breadth of processes in which people may assign meaning to a product that integrates both physical and digital forms. In Chapter 2, we discussed the state of existing research in defining the various levels of abstraction of attachment in physical and digital contexts. From our own research detailed in Chapter 5, we found a distinct divide between the perceptions and value of a technological product's physical and digital components. The findings of our study showed that personal digital media often contained higher emotional value than the physicality of personal tech devices. The emotional value of digital media was often ascribed to what is *accessible* rather than what is *owned*. An owned mp3 copy of a song was reported as no more meaningful than any other digital instantiation of the same song.

We propose that physical-digital products are often perceived as a system of products rather than as singular devices. Digital information is conceptually distinct from the materiality of the devices that enable their creation, access and manipulation. Comparatively speaking, our example of a digital camera is a simple technological product, containing only one form of digital media. The complexity of meaning abstraction is further heightened in multimedia devices such as smartphones, laptops or tablets and through the usage of cloud-based storage and online streaming services.

While the levels of abstraction outlined above create distinctions between various aspects of a physical-digital product, the processes that lead a person to assign meaning to a possession may be less divisive. Individual objects can be valued for their place within a meaningful collection (Belk, 2013; Marshall, 2007). There are also complex *layers* of meaning assigned to possessions, relating to both physical and digital components to varying degrees. Still, our findings highlight the divide between physical and digital meaning to be a common occurrence in current user-object relationships.

### 7.2.2 Issues and Implications

Distinctions between the perception of physical and digital components of technological products consequently leads to changes in the experience of attachment. The assignment of meaning to a digital item, collection or singular physical object varies in the ways they enable or prohibit certain meaning-making processes. Digital possessions are hidden within devices until called upon, limiting their presence in the day-to-day lives of users and capacity for public display (Kirk & Sellen, 2010). This affects the level of engagement and sense of pride that users may experience with meaningful digital possessions (Brown & Sellen, 2006). The immaterial nature of digital possessions can make it difficult for users to establish a sense of ownership and uniqueness that is inherent to product attachment experiences (Denegri-Knott et al., 2012; Odom et al., 2014). The transient nature of digital information provides users with accessibility from a range of locations and devices (Brodersen et al., 2007). This creates instances in which users can engage in meaningful practices through their interactions with *ecologies* of artefacts, easing the process of incorporating new technologies into their lives (Bødker & Klokmose, 2012; Jung & Stolterman, 2012). From a meaning-making perspective, the experiential differences between attachments to physical or digital *things* do not appear to be a substantial concern. Product-related constructs of attachment are just one portion of a broader context of meaning-making processes that occur through people's ongoing relationships with places, people, practices, experiences and things.

From a sustainability perspective, the divide between physical and digital meaning is a significant issue. Technological products are being disposed of and replaced at an alarming rate. In his inaugural lecture, Chapman (2014a) cited:

> *"In terms of consumer electronics, […] we create 40 tonnes of waste to produce just 1 tonne of products. Of that 1 tonne of products, 98% of them are discarded within just 6 months of purchase"*

This rate of consumption referred by Huang and Truong (2008) as a "*disposable technology paradigm*" (p. 323) amplifies a number of sustainability issues such as resource scarcity and e-waste management (Deng et al., 2017). Material consumption has been said to be primarily driven by discrepancies between the *actual* and *desired* conditions of an individual (Chapman, 2014b). Promoting the emotional desirability of a product has

been considered a viable strategy to address these issues with our current rate of product consumption (Gegenbauer & Huang, 2012; Huang & Truong, 2008; Odom et al., 2009). The findings of our study detailed in Chapter 5 echoed the concerns raised above in terms of the perceived replaceability of technological products. The emotional significance of these products was often associated with the digital information and not the specific owned object, diminishing its value for promoting sustainable product consumption outcomes (Mugge, Schoormans, et al., 2005).

The divide between physical and digital meanings has further implications on the ways in which attachment to technological products is measured and evaluated. Early studies that compared the emotional significance of physical, physical-digital and digital possessions often concluded that physical-digital and digital possessions were less likely to be valued (Golsteijn et al., 2012; Kirk & Sellen, 2010; Odom & Pierce, 2009). The structuring of each of these studies asked participants to report on the emotional value of physical-digital possessions as a whole. These summative evaluations may be insufficient in addressing the felt experiences of attachment towards physical-digital products. Studies measuring product-related attachments have traditionally assessed responses in relation to the criteria of *irreplaceability* (Kleine et al., 1995; Schifferstein & Zwartkruis-Pelgrim, 2008; Schultz et al., 1989) however the irreplaceability of a possession can become difficult to conceptualise in digital contexts (Feinberg, 2013). Further explorations of attachment in the context of physical-digital products must adopt procedures that acknowledge the conceptual divide between physical and digital meanings to accurately report on the experiences of research participants.

### 7.2.3 Narrowing the Physical-Digital Divide

Many researchers have explored ways to narrow the physical-digital divide in technological products through the development of tangible methods of interaction with digital media and functionality (Fitzmaurice, 1996; Golsteijn et al., 2014; Ishii & Ullmer, 1997; Kirk & Sellen, 2010; van den Hoven & Eggen, 2004; West et al., 2007). Prevailing barriers to closer integration include the interchangeable nature of physical devices (Brodersen et al., 2007) and widespread adoption of cloud-based computing and streaming services that blur lines between ownership and access of digital media (Odom et al., 2014).

The field of product design is becoming increasingly integrated with interaction design (Vallgårda & Redström, 2007). In order to effectively integrate physical and digital forms, product design practice must adapt to emerging interaction design issues. The integration of digital functionality into physical products brings fundamental changes to the ways in which users perceive and value the materiality of the product itself. Digital innovation has drastically changed many aspects of everyday life, including the ways in which people communicate with others, conduct business and spend their leisure time (Barrett, Davidson, Prabhu, & Vargo, 2015). Product designers must continue to rethink the role of objects in an economy that is becoming increasingly centred on digital products and services.

A promising finding from the study detailed in Chapter 6 was the ease of which our participant Andrew was able to conceptualise his digital music collection in material terms. We found a group of digital music was able to be collectively related to a particular material image, such as a punk character or people sharing stories around a fire. This provides an opportunity for narrowing the divide between the singularity of physical devices and the multiplicity of digital media by creating devices that share associative ties with their digital contents.

## 7.3 Meaningful Associations

Meaningful memories and associations are often argued to be key determinants for strong degrees of product attachment (Csikszentmihalyi & Rochberg-Halton, 1981; Kujala & Nurkka, 2012; Page, 2014; Schifferstein & Zwartkruis-Pelgrim, 2008). Despite this, associations are often given little attention in product attachment literature that seeks to inform designers through the development of design strategies and guidelines. The potential value of utilising meaningful associations to promote product attachment has not yet been explored in design practice. We discuss our strategy for designing products with meaningful associations as a method of promoting product attachment among users based on our implementation and evaluation of the strategy detailed in Chapters 4 and 6.

### 7.3.1 Defining Meaningful Associations

We define meaningful associations as *mental connections to a concept, event or mental state that characterises, communicates, maintains or develops an aspect of the individual's self-identity*. Meaningful associations are personal links that are unique to the individual. We use the term associations to broadly encompass the different levels of thoughts and memories that come to mind as part of the remembering-imagining system (Conway & Loveday, 2015). Personal associations are not just links to specific episodic memories, but also to general events, life periods or broader themes that fit within the life story (Bluck & Habermas, 2000). Associations also include reflective thoughts and feelings or imagined futures derived from memories (Zijlema et al., 2016).

For an association to be meaningful, it must contain links to the individual's self-identity. Throughout the research conducted as part of this thesis, we have found people to consider an object to be meaningful for its associations to loved ones, defining periods of life, specific events, personal ideologies, values, personality traits and empowering activities or practices.

### 7.3.2 A Design Strategy for Promoting Product Attachment

Product attachment theory has highlighted the prevalent role of meaningful associations in the development of attachment but as of yet has not applied these insights to design practice. There are several ways in which a product becomes associated by the user to a source of meaning, however the designer's influence over a user's experience is limited. Objects can develop meaningful associations over time through the individual's history of ownership, such as the presence or use of the object in significant moments or in recurring practices. While this is the most common way in which meaningful associations develop (Page, 2014), it remains difficult to account for in design practice as designers cannot control the length of time in which a product will be actively engaged with by the end user. Objects can alternately gain meaningful associations in the early stages of acquirement through an individual's response to interactive elements of usage, their material properties such as form, colour, texture, size and smell or through the way in which the object is acquired.

Our design strategy involves a process of designing objects with material or interactive properties that mentally pair with concepts that have been identified as

meaningful to the intended user. This pairing process requires a deep knowledge of an intended user's life narrative and their personal understandings of material properties and product experiences in order to evoke the identified concept in a way that is deemed meaningful. From the evaluations of our seven designs that adopted the strategy for designing objects with meaningful associations (detailed in Chapters 4 and 6), we achieved mixed levels of success in promoting the formation of product attachment. There were however several promising instances of designs resulting from this process being associated with meaningful personal experiences and described by users in highly emotive terms.

The small sample of designs (7) and participants (4), the short time frame of evaluations (2 to 5 weeks) and the mixed levels of success in evoking meaningful associations limit any claims of the generalisability of our findings and the effectiveness of our design strategy across broader contexts. This limitation is inherent to our adoption of research through design processes that instead decidedly remain future-oriented (Zimmerman & Forlizzi, 2008). This future-oriented perspective shifts our focus from producing a design strategy that is *generalisable* to one that is *extensible* (Zimmerman, Forlizzi, & Evenson, 2007). Our process and resulting artefacts aim to serve as specific instantiations of product attachment theory that begin to bridge current design practice toward our proposed, preferred state of human-object relationships. While by no means conclusive, the success of several designs stemming from our process for designing meaningful objects suggests the merit of continuing to explore the value of meaningful associations as a means of promoting product attachment.

We provide an overview of our process for designing meaningful objects, both physical and physical-digital, in Table 7. This process should not be seen as a prescriptive template for design practitioners, but instead as a source of inspiration for designers attempting to promote product attachment within their design processes.

| Phase | | Description | Example Methods |
|---|---|---|---|
| 1 | Meaningful Mental Concepts | Develop an understanding of mental concepts that are sources of meaning for the intended user (e.g. *30th birthday* or *travel*). This understanding should be centred on the intended user's life narrative and sense of self. | Interviews<br>Narrative inquiry<br>Probe methodology |
| 2 | Mental Concept Associations and Imagery | Identify the associations and imagery brought to mind by the meaningful mental concepts, including emotions, values, personality traits, memories, experiences, people, places, time periods and aesthetic or sensory properties (e.g. visuals and sounds linked to a particular memory). | Interviews<br>Probe methodology<br>Visualisation methods (e.g. mood boards) |
| 3 | Product Properties | Identify the intended user's general views towards various product properties including aesthetics (e.g. colour, texture, material, form) and product functions (e.g. decorative, practical, social, contemplative or active). | Interviews<br>Probe methodology<br>Questionnaires |
| 4 | Synthesise Properties | Group together meaningful mental concepts, aesthetic qualities and product functions that share cohesive characteristics. This phase should result in several distinct groups of properties. | Affinity mapping<br>Thematic analysis |
| 5 | Concept Generation | Generate design concepts from each of the grouped properties, using the identified mental concepts, associations and imagery as driving factors for design decisions. | Brainstorming<br>Sketching<br>Model making |
| 6 | Concept Evaluation | Evaluate concepts in regard to their predicted meaningfulness, authenticity and clarity to determine the most suitable direction to pursue towards a final design. | User feedback<br>Prototyping |

**Table 7. Overview of a process for designing meaningful objects.**

### *Phase 1: Meaningful Mental Concepts*

The process outlined in Table 7 begins by uncovering a variety of sources of meaning for the intended user. This meaning may stem from past experiences, ties to significant others, recurring activities, aspirations for the future, ties to places or personal values. To allow for broad explorations and flexibility within the subsequent design process, it is ideal to identify meaningful mental concepts that range in specificity. For example, conducting open-ended discussions with an individual may reveal that they consider their ongoing relationship with their family, memories of their wedding day and the night sky as sources of personal meaning. These three example mental concepts of *family*, *wedding day* and *night sky* range from abstract to concrete, providing a variety of directions to explore within a design process.

### *Phase 2: Mental Concept Associations and Imagery*

The process of designing meaningful objects aims to associate personal meanings with a newly created material artefact. Doing so requires an understanding of the ways in which the intended user perceives the mental concepts identified in phase 1 in material terms. This involves identifying the associations and imagery brought to mind by the meaningful mental concepts. These associations and imagery are often abstract and ill-defined, providing a sense of the mental concept rather than a clear depiction. For example, the mental concept of *family* may evoke a broad range of associations including positive emotions, shared personality traits, occasions spent together and aesthetic characteristics of the family home. Associations and imagery can come from either the recollection or imagining of experiences, reflecting the remembering-imagining system outlined by Conway and Loveday (2015).

### *Phase 3: Product Properties*

Through our encounters with the world around us, we each form associative understandings of physical properties such as colour, material, form, texture, size and weight. These pre-constructed understandings influence the way we respond to a newly introduced product based on its material properties. For example, a person may consider wood to be *natural*, metal to be *cold,* and glass to be *fragile.* It is therefore important to factor in a person's views of product properties when attempting to materialise meaningful mental concepts to ensure they support rather than obstruct this translation. There are several methods in which a person's views of product properties can be revealed, such as interviews, questionnaires or through probing methods. When designing a physical-digital product, this phase should also include developing an understanding of a person's views of various digital properties such as modes of interaction and types of media.

### *Phase 4: Synthesise Properties*

This phase involves synthesising the data collected in phases 1–3 relating to a person's meaningful mental concepts, associations, imagery and pre-constructed understandings of product properties. Data should be grouped to create several clusters of cohesive characteristics to use as a basis for the subsequent design process. For example, the meaningful mental concept of the *night sky* might best be grouped with other associations

such as *late-night walks* or *camping*, aesthetic properties such as *cool colour tones* and product categories that have a spatial presence such as a *lamp*.

This grouping process can focus on a particular property depending on the requirements of the project at hand. For example, in the creation of *Story Shell*, Moncur et al. (2015) focused their design process on a particular mental concept, the intended user's ties with a deceased family member. Lacey (2009) explored the creation of meaningful objects within her practice of working with ceramics. In our own process detailed in Chapter 6, we restricted our process to the design of a music player, exploring the meaningful mental concepts, associations and imagery that related to the intended user's music library.

### *Phase 5: Concept Generation*

Design concepts can be generated by deriving design decisions from each of the groupings of properties. The process of generating concepts should not make use of source material in a prescriptive manner. Phases 1–4 of the process are intended to provide a sufficient understanding of the user in order to create a design they perceive to be an *authentic* representation of a *meaningful* aspect of their identity. From our own experiences, formulating concepts that evoke a sense of authenticity in their connection to an existing source of personal meaning relies on implicit understandings of the individual being designed for. All source material should therefore be seen as solely inspirational, allowing the process to also be driven by the tacit knowledge of the designer or design team.

Application of the strategy for designing objects with meaningful associations should be adapted to fit the type of product being designed. Decorative products such as jewellery or candle covers have minimal functionality requirements, allowing for a diverse range of aesthetic imagery to be incorporated within the design. These products are also singular and can draw inspiration from specific episodic memories to gain meaning. Technological products have both functional requirements and collections of personal digital information stored or accessed from within them. In these instances, greater consideration must be given to the associative thoughts evoked by interactions with the product during usage. As these products contain collections of digital items, imagery incorporated into the design process should relate to broader themes of identity or life

periods that encompass the collection as a whole for the intended user, rather than specific events that may only relate to a fraction of the digital items found within the collection.

*Phase 6: Concept Evaluation*

Concepts should be evaluated in regard to the meaningfulness of their source of inspiration, the degree of clarity in which they embody the meaningful mental concepts and the authenticity of the translation of the personal meaning into a material form. This evaluation process relies on the designer's implicit knowledge of the intended user. It may also be beneficial to involve the user within the evaluation to ensure the design successfully evokes the intended meaningful associations. While the design processes detailed in Chapters 4 and 6 did not involve users in the evaluation of concepts, this was to accommodate other research goals within evaluations of the resulting designs. Concepts should also be evaluated in regard to general principles of good design. Impractical or poorly constructed designs are likely to evoke negative appraisals that can diminish their overall significance.

### 7.3.3 Benefits and Limitations

Utilising meaningful associations within a design process holds a number of benefits for end users and sustainable resource usage. As a strategy for promoting the development of product attachment, designing objects with meaningful associations brings emotional value to the object in the initial stages of acquirement. This has advantages over existing design strategies that require users to develop a meaningful relationship with the object over an extended period of time (Mugge, Schifferstein, et al., 2005b) as it is not dependent on the user actively engaging with the object until it acquires meaning. The diversity of meaningful associations allows the strategy to be applicable to any type of consumer product, including decorative, utilitarian and technological products. In the case of technological products, meaningful associations also provide an opportunity for integrating physical and digital form by translating the significance of the digital information into the physical design.

Our strategy of actively including meaningful associations within the design of a product has potential to evoke strong levels of attachment among intended users. The strategy contributes to the personal significance of the product through promoting ties to memories and the user's sense of self, qualities that have been identified as primary

determinants of product attachment (Niinimäki & Koskinen, 2011; Page, 2014; Schifferstein & Zwartkruis-Pelgrim, 2008). This personal significance is not easily replaced, improving the longevity of the product lifetime (Mugge, Schoormans, et al., 2005). Product longevity is a core sustainability issue that has seen increased attention in recent years, illustrated by the recent inception of the Product Lifetimes and the Environment (PLATE) conference in 2015. Early methods for addressing the environmental impact of products such as the Life Cycle Analysis (LCA) approach ask designers to consider the effect of all stages of a products life, including the extraction of raw materials, manufacture, distribution, usage and end of life disposal. This approach has been criticised for neglecting a fundamental problem: the short lifetime of products (Verbeek & Kockelkoren, 1998). This issue often points towards problems in our throwaway culture rather than the durability of the products themselves (Chapman, 2008; Cooper, 2002; Huang & Truong, 2008; Odom et al., 2009). Designing objects with meaningful associations aims to directly address this cultural issue by ridding people of the desire to replace their belongings, even when a demonstrably superior product is obtainable.

While designing objects with meaningful associations has strong potential for promoting product attachment, it also has a number of limitations to its adoption in design practice. Most notably, this design strategy implements a resource-intensive bespoke process for each individual user, something that is often not possible in traditional design practice. The limitations of adopting a bespoke process may however be inherent to any attempts to promote product attachment due to the personal nature of attachment experiences (Desmet et al., 2001; Niinimäki & Koskinen, 2011). The viability of this process is expected to improve with ongoing advancements in custom manufacturing technology such as additive manufacturing that further enable bespoke design practice. These advancements continue to improve the flexibility of manufacturing processes, reducing the barriers in place to produce bespoke products. Advanced manufacturing processes such as 3D printing and multi-axis machining also impose fewer restrictions on product form, streamlining the process of design for manufacturability. The process of designing products in such a way that they are easy to manufacture and assemble is often the most time-intensive phase of product design practice. While this streamlining of design for manufacturability processes will not offset the resource-

intensive process required for a bespoke product, it is likely to significantly improve the efficiency and applicability of bespoke design processes.

A second limitation of designing objects with meaningful associations stems from the uncertainty of its outcomes. Eliciting a desired associative response in an intended user is a difficult design challenge that cannot be resolved by standardised design guidelines. Evaluative responses to products are unique to the individual and ephemeral, limiting designers to create possibilities instead of certainties in cueing personal meaning (Hassenzahl, 2004). Finally, a person's need for self-expression is finite (Chernev et al., 2011), thus there is a limit to the number of products that an individual will use to represent their individuality and integrate into their established sense of self.

## 7.4 Reflections on our Design Processes and Material Outcomes

Each of the studies conducted as part of this thesis involved a process of developing tools and activities to aid us in generating insights that address our research objectives. In this section, we reflect on the development, implementation and outcomes of these tools and activities to identify common themes and their value in research projects.

### 7.4.1 Adapting Probe Methodology

In the studies detailed in Chapters 3, 4, 5 and 6, we developed novel adaptations of probe methodology as part of our exploration into particular issues relating to the design of meaningful objects. The research tools and activities we developed for probing purposes were inspired by the wealth of probe methodology first developed by Gaver, Dunne and Pacenti (1999) and since adapted to a variety of research purposes within the HCI community (Boehner et al., 2007). Our approach echoes some of the underlying values of these methods and deviates from others. Aesthetic qualities of our probing materials such as *Identity Timelines* and *Association Cards* (see Figure 40) were softened to create a personal and intimate feel that deliberately diverges from the impersonal feeling of official-looking questionnaires much like Gaver et al. (1999). While our usage of probe methodology aligns with its three fundamental qualities—being design oriented, concerning the users' subjective world and being based on self-documentation

(Mattelmäki, 2005), our adaptation of the method deviates from its original function as a source of design inspiration. We used probing activities to generate *information* rather than *inspiration* much like Crabtree et al. (2003) and Hemmings et al. (2002). We did not use this information as a standalone source of findings, but rather as a supplement to the data gathered during interview sessions. We also used probing activities as a means of sensitising participants to complex felt experiences, acting as an agent for more insightful researcher-participant dialogue. While each of our probing tools and activities were developed specifically for the project at hand, we collectively reflect on our adaptation of probing methods to discuss recurring themes to their features and the value they brought to gathering insightful data.


**Figure 40. Assorted probing tools and activities used to gather data.**

### *Structuring Subjectivity*

Each of the tasks developed as part of our data collection was highly structured in the nature of what it asked of our participants. For example, *Association Cards* (see Chapters 4, 5 and 6) asked participants to list all of the associations that came to mind when engaging with a particular object, collection, item or music category. *Object Interventions* (see Chapter 3) asked participants to substitute several of their existing household belongings with newly introduced versions of the same product. While the tasks themselves were structured, the resulting responses provided by our participants were highly subjective as our queries related to personal user-object relationships. The structured foundation and subjective output of our probing tasks adopt similar principles to semi-structured interviews that follow a guide but also allow for unanticipated topics to be addressed (Denzin & Lincoln, 2005).

The use of structured, subjective tasks has value for both qualitative researchers and participants. For the researcher, the structuring of probing activities provides greater control over the area of focus addressed through interactions with the participant. This

narrowed focus also provides greater clarity in the comparison and analysis of findings with multiple participants. For the participant, structured probing tasks can aid with comprehension and communication of personal thoughts. For example, by completing Object, Collection and Item *Association Cards* (detailed in Chapter 5), participants were sensitised to the process of conceptually distinguishing between physical and digital components of their belongings. They were then able to clearly articulate these distinctions, leading to new insights into product attachment in physical-digital contexts. The open-ended subjectivity of queries asked of participants in completing our tasks provided freedom of expression not possible in other structured methods used to study attachment such as questionnaires (Schifferstein & Zwartkruis-Pelgrim, 2008; Schultz et al., 1989) or Q-methodology (Kleine et al., 1995), a process for comparatively rating factors to determine their relative importance.

### *Comparative Evaluations*

In each of our studies, we used the materials generated in response to probing activities in a follow-up spatial rating task to comparatively evaluate and discuss their value. For example, in Chapter 3 we asked participants to spatially rate the products involved in the *Object Interventions* activity on scales from *me–not me* and *strong emotional attachment–no emotional attachment* and in Chapter 6 we asked our participant to spatially rate our designed objects on a scale from *meaningful–meaningless*. Through our repeated use, we found comparative evaluations to provide clarity to the conversations shared with our participants. As researchers, these comparisons aided our understanding of the resulting significance of belongings featured in the lives of participants. The spatial positioning of items often acted as props to our conversations with participants, allowing us to identify patterns for further inquiry and allowing participants to reflect, revise and articulate their reasoning in real time. By providing points of comparison, we found participants were better able to identify underlying reasons for personal significance, enhancing the clarity and certainty of their judgements.

### *Facilitating Insightful Dialogue*

While the probing activities completed by our participants provided ample data, we did not use this data as a primary source for producing research findings. The highly subjective nature of our tasks limits the quantifiable claims that can be made from

analysing results. These probing activities primarily served to uncover insights that may be overlooked in solely conversational methods of inquiry. For us as researchers, the use of probing methods brought clarity to our understanding of the intended meanings of participant's verbal responses, aiding our analysis of transcript data. For participants, these activities provided greater freedom in voicing their experiences and thought processes that can be difficult to eloquently communicate through conversation alone. An example of this can be seen in our final interview with Louise in which she listed associations that came to mind when engaging with *Diramu*, a candle cover designed as part of the study detailed in Chapter 4. In completing the probing activity, she was able to freely list vague thoughts that came to mind such as *home* that were then difficult to describe verbally: "*I don't know… just the smell of it had a certain… I don't know… feeling of home*". Probing activities can provide participants with a less formal method of communicating their thoughts and feelings to bring forth insights that might otherwise remain unsaid (Wallace et al., 2013).

### 7.4.2 Creating Research Products

In the studies detailed in Chapters 4 and 6, we applied a research through design approach (Frayling, 1993) to support our investigation into distinct kinds of human-object relationships and experiences. Within these chapters, we reflected on our attempts to incorporate meaningful associations within our design process and discussed the resulting findings from the deployment of our designs with the intended user. In this section, we critically reflect on the making process to identify a number of tensions that we faced when conducting research through design.


**Figure 41. Assorted research products created to gather data.**

Many constructive design projects develop their designs in accordance with a particular research interest and then assess the design's potential through user-testing or critical reflection (see Golsteijn et al., 2014; Helmes, O'Hara, Vilar, & Taylor, 2011; Lacey, 2009; Lee et al., 2016; Mols, van den Hoven, & Eggen, 2016; Odom et al., 2018; van den Hoven & Eggen, 2004; Van Krieken et al., 2012). We adopted the alternative approach of gathering user data to inform the creative process and development of the design (see Desmet et al., 2001; Hermans, Broekhuijsen, & Markopoulos, 2017; Moncur et al., 2015; Ozenc et al., 2007; Reitsma, Smith, & Van Den Hoven, 2013; Tsai, Wang, Lee, Liang, & Hsu, 2014). Projects involving user data throughout the design process emphasise the coexistence of roles and needs in the relationship between the designer-researcher and user-participant. Balancing these needs plays an important part in successfully engaging in research-led design practice.

A primary consideration for balancing designer-researcher and user-participant needs is the degree of subjectivity involved in the interpretation of data. On one end, there is the subjective interpretation of *inspirational data* generated from cultural probes (Gaver et al., 1999) and on the other end, there is the predominantly structured interpretation of quantifiable information generated from methods such as surveys and questionnaires (Wolf, Joye, Smith, & Fu, 2016). Data that is open to subjective interpretation provides creative freedom to the designer in their development of design ideas but in doing so, may soften the voice of the participant. Highly subjective data can also fail to provide clear guidance for design processes (Gaver, Boucher, Pennington, & Walker, 2004). Data that is primarily structured in interpretation may empower the voice of the participant but in doing so restrains the creative expression of the designer to a set of user requirements, limiting their ability to explore avenues not directly addressed by the data. Quantified data may also limit the flexibility of the designer, something that is often required when working with particular materials, processes or constructive skillsets. We argue that to effectively utilise user-research data within design processes, both the creative freedom of the designer and the voice of the user must be balanced. This can be achieved by conducting research that provides the designer with both *implicit* and *explicit* understandings of the user to inform their practice. Implicit understandings can extend the voice of the user whilst providing space for creative exploration. Explicit

understandings provide guidance to the designer in their development of ideas and reassurance in the accuracy of their interpretations of data. An example of using both *implicit* and *explicit* understandings of our user can be seen in our process for developing *Diramu,* a candle cover for one of our participants detailed in Chapter 4. The candle cover used imagery of an Australian bushfire as a primary source of inspiration for the design. Bushfires were explicitly mentioned by our participant to evoke powerful emotions. We relied on our implicit understandings from her recollection of an encounter with a bushfire as a child to identify this experience to be a personally significant and positive memory.

### *Researcher vs Designer Values*

The primary values adopted in scientific research and design practice can significantly vary. For individuals who adopt the joint role of designer-researcher, these differences can bring tension to the process of creating research prototypes or products. As a researcher, created artefacts often serve as a method of inquiry, acting as a tool for data collection and to explore new concepts in practice. As a designer, the sole objective of the creative process is often the resulting artefact itself, refined to a level of detail that signifies the completion of the process. These differences in the intended outcome of the creation of an artefact lead to differences in the priorities that inform design decisions throughout its development. As researchers, we sought to create artefacts that provide insights to our research questions. Beyond these goals, we also sought to produce highly resolved, well-finished designs that were enjoyable to engage with. This tension also came through in our use of participant data to inform design decisions in which staying true to the research findings at times conflicted with our own personal evaluations and inclinations for *good* design. Personal preferences may have influenced our analysis and translation of data into design decisions. We found the creation of *research products* (Odom et al., 2016) rather than *research prototypes* to be an effective method of harmonising research and design-related intentions and in realising both research and design outcomes. Enabling people to engage with the resulting artefact for what it *is* rather than what it *might become* ensures that design intentions can more clearly be evaluated.

The creation of highly resolved designed artefacts requires a more substantial dedication of time than is often found in user research processes. In their inquiry of

supporting longer-term relations with everyday computation objects, Odom et al. (2018) designed two artefacts over a two and a half year period. Moncur et al. (2015) adopted a participatory design process to create and evaluate a bespoke digital memorial over seventeen weeks. In our own studies, the development and creation of well-finished research products, detailed in Chapters 4 and 6, took several months to complete. These development processes more closely reflect the level of detail considered in product design practice. As researchers, this lengthy process posed a greater risk of having participants drop out of a project prior to its completion. To account for this, we took additional steps in screening participants and were fortunate to have participants willing to remain involved in our studies over these extended periods of time. We also structured our concluding interview sessions to mirror some of the activities completed in the initial interview sessions to aid participants in reflecting upon their responses throughout the entire study period.

The intersection of scientific research and design practice values can also bring about positive deviations to the roles typically adopted in each context. Designing for research purposes brings additional outcomes beyond the end product itself in the form of findings and insights. We found this shift towards non-material outcomes provided greater acceptance for design 'failures', leading to more novel and innovative exploration than is typically found in traditional design practice. Some of our research products did not evoke the user responses we set out to achieve. Some we were unable to resolve to a material standard we had hoped for while progressing with a particular concept. These shortcomings in our material outcomes were more than supplemented by the richness of our creative process and the insights obtained from reflecting upon our practice. Incorporating design practice within our research process conversely enhanced our understandings of the phenomenon we were examining. Engaging in design practice broadened the scope of our research inquiry to more holistically consider the nuances of human-object relationships in complex real life contexts (Wrigley et al., 2010).

## 7.5 Considerations for Designing Meaningful Objects

Despite substantial contributions being made to advance our understanding of why and how people develop attachments, little progress has been made in applying this theory to design practice. Inciting people to engage in meaning-making processes is a challenging and fickle design objective (Hassenzahl, 2004; Niinimäki & Koskinen, 2011). Simply put, there are a number of factors involved in the development of attachments that are beyond a designer's control. Factors that are within the scope of design often compete with the demands of consumer markets and modern manufacturing processes. The research project detailed within this thesis has sought to consider these challenges in developing insights for promoting product attachment through design practice. To take steps towards bridging the gap between product attachment theory and design practice, we present six design considerations for practitioners seeking to create meaningful objects. These considerations are based on the findings and critical reflections on the research presented in the preceding chapters of this thesis.

### 7.5.1 Meaning is Unique to the Individual

People develop attachments to things external to themselves as a result of *self-extension* processes, expanding one's sense of self to include significant people, places, objects and experiences (Belk, 1988). These attachments aid us in constructing, maintaining, developing or communicating aspects of our self-identity (Ball & Tasaki, 1992; Csikszentmihalyi & Rochberg-Halton, 1981; Schultz et al., 1989; Wallendorf & Arnould, 1988). A part of this *self-extension* process is inherently unique to the individual as people are motivated to establish an identity that is distinct from that of others (Kleine et al., 1995). As attachment is a highly personal phenomenon, attempts to promote product attachment should adopt a process of designing for individuals. Designing for an individual conflicts with established mass production processes that are currently widely adopted in product design practice. Strategies for promoting attachment within design processes proposed in prior research often appoint the need for applicability within existing mass production processes over the need for personal solutions (Mugge et al., 2008; Odom & Pierce, 2009; Page, 2014; Schifferstein & Zwartkruis-Pelgrim, 2008).

While developing products that are meaningful for a broad range of users would be ideal, the unique nature of attachment experiences limits the feasibility of any generalised solutions (Desmet et al., 2001).

In the initial stages of this research project, we were discontent with the degree to which existing design strategies were able to promote the development of meaningful user-object relationships. The effectiveness of many existing strategies remains unverified and those that have been evaluated by potential users often conclude that no single design will hold meaning for all users (Desmet et al., 2001; Lacey, 2009). In our own work, we diverged from traditional product and interaction design considerations to focus on best practice for promoting product attachment, designing solely for the individual. While not extensive, the findings of our user evaluations showed potential for significant increases to the meaningfulness of newly designed products for the intended user. In order to effectively design meaningful objects, designers must adopt processes that focus on the individual user and their unique values, beliefs and experiences.

### 7.5.2 Meaning Manifests in Countless Ways

The meaning assigned to a possession can stem from a diverse range of internal and external sources, including various aspects of the life of the owner and the experiential qualities of the possession itself. Several researchers have formulated categories to encompass the varied reasons that people give for cherishing a possession with recurring themes related to memories, enjoyment, self-image, group affiliations, utility and appearance (Battarbee & Mattelmäki, 2004; Csikszentmihalyi & Rochberg-Halton, 1981; Kleine et al., 1995; Mugge, Schifferstein, et al., 2005a; Richins, 1994; Schifferstein & Zwartkruis-Pelgrim, 2008). While these recurring categories reflect aspects of life that people similarly find to be meaningful, the ways in which this meaning is manifested are endlessly diverse. Throughout the studies conducted as part of this thesis, we found the sources of meaning described by our participants to be far more divergent and unique than the categorised summative findings presented in prior literature would have us believe. For example, in study 1 (Chapter 3), a participant valued a tea towel for *"appealing to [her] sense of humour"* [P2]. In study 2 (Chapter 4), Louise informed us that every time she wears her ruby earrings, they remind her of *"ravioli and tomato sauce"*. In study 3 (Chapter 5), a participant associated a significant song with *gossip, embarrassment* and

being *scared* [P7]. These examples show that while meaning often stems from particular aspects of a person's life (such as their memories or self-image), this meaning is actualised in countless ways.

### 7.5.3 Product Function Influences Meaning

A product's function often dictates the day-to-day scenarios in which it is seen or used. Designers aiming to create meaningful objects must consider the ways in which a product's function may enhance or detract from the meaning it acquires. We found our process of designing meaningful objects to be most successful when we established continuity between the associated meaning and the context of use. For example, in the study detailed in Chapter 4 we sought to create an object that reflected our participant's relationship with their youngest son through their shared appreciation of geometric patterns. This process resulted in *Geo*, a set of placemats and coasters that were used by our participant during family dinners. In this instance, the product's function (to protect and decorate a dining table during meals) created a context of use that shares characteristics with the intended source of meaning (representing the user's relationship with their son). In efforts to design meaningful objects, the function of a product should be considered alongside design decisions relating to its material and interactive properties in order to create a cohesive product experience that effectively evokes personal meaning for the intended user.

### 7.5.4 Association Specificity Influences Clarity of Meaning

Objects are often considered meaningful for traits beyond their own materiality, extending to their associations to beliefs, experiences, memories, people, places or values that are significant to their owner. These associations are what enable people to use objects to characterise, communicate or develop an aspect of their self-identity. Designing meaningful objects involves facilitating the development of associations between the object and mental concepts that hold personal significance for the intended user. While our process attempts to do this by tapping into meaningful imagery already in the mind of the user, others have focused their attention on evoking a meaningful tactile experience (Lacey, 2009) or helping the user to become the person they desire to be (Zimmerman, 2009).

Our findings suggest that the specificity of the associations evoked by an object influences the clarity of its meaning to the individual. Evoking associations to a person's memories of a particular event (e.g. *21st birthday*) is likely to form a clearer image in their mind than evoking associations to a broad period of time in their life (e.g. *childhood*) or one of their personal interests (e.g. *cooking*). An example from our own designs can be seen in the effectiveness of *Diramu,* the candle cover from the study detailed in Chapter 4. The design of *Diramu* cued memories of the user's past encounter with a bushfire and was considered highly meaningful in doing so. Other designs were associated with more abstract personal concepts, such as *family, winter* and *skiing*, but were not considered as meaningful in doing so. Specific associations were found to provide definitive links to personal imagery and allow for more engaging design representations.

### 7.5.5 Object Meaningfulness Influences Material Consumption

There are many ways in which people characterise, communicate and develop their sense of self. Significant relationships to other people, practices, experiences, places and events all facilitate meaning-making processes. There are however contextual differences that must be considered when attempting to promote meaning-making processes in each of these scenarios. In the context of product attachment, the longevity of emotional user-object relationships is a key concern due to the destructive nature of the throwaway society. Chapman (2014b) argues "*durability is just as much about emotion, love, value, and attachment, as it is fractured polymers, worn gaskets, or blown circuitry*" (p. 142). To meet growing demands for sustainable design practice, designers seeking to create meaningful objects must also aim to create objects that are resistant to disposal or replacement with value assigned to their unique materiality. The need for meaningful singular objects is perhaps most prevalent in the growing sector of physical-digital products. Many products are becoming increasingly centred on their digital functionality with some researchers identifying the *ecologies* of interchangeable artefacts that people use (Bødker & Klokmose, 2015; Brodersen et al., 2007; Jung et al., 2008) and others calling for greater emphasis to be given to physical interactions (Dourish, 2004; Ehn & Linde, 2004). We argue the need for bespoke design practice in which specific one-off designs are produced for an intended user to successfully create meaningful objects that address issues with product consumption rates.

The notion of the bespoke product designer is not novel (Campbell, Hague, Sener, & Wormald, 2003) but remains rare in commercial practice. In contrast to this, bespoke design practices are considered the norm in the field of architecture, partly out of necessity to account for specific site conditions. Other instances of bespoke design practices already exist in the form of bespoke tailoring, custom-made business cards and even art commissioned portrait paintings intended to portray the identity of an individual. We propose that bespoke design practices should further be adopted as a means of promoting product attachment for its ability to facilitate personal significance within a possession. This can already be seen in certain areas of product design such as jewellery design, in which bespoke wedding rings are designed for a particular engaged couple.

Adopting bespoke product design practices to create meaningful objects is not universally applicable. The production, acquirement, usage and disposal of certain product categories detract from their suitability for following bespoke processes such as those presented in this thesis. We provide an illustrative table of example product categories ranging from most to least suitable for creating meaning in the ways outlined throughout this thesis (see Table 8). This table is intended to be inspirational rather than prescriptive in nature and is not definitive by any means. Broadly speaking, we see personal products used by a sole individual to be well suited to bespoke design processes.

| | Description | Physical Examples | Physical-Digital Examples |
|---|---|---|---|
| Most suitable | Personal products privately used and owned by an individual | Jewellery, watches, clothing, stuffed animals, musical instruments | Smartphones, activity trackers, mp3 players, smart watches, hearing aids |
| ↓ | Personal products primarily used and owned by an individual | Furniture, stationary, books, vehicles, headphones | Laptops, e-book readers, USB flash drives, tablets |
| → | Shared products used by a known group of individuals | Dinnerware, kitchen appliances, carpets, office equipment | Smart TVs, GPS units, game consoles, projectors |
| Least suitable | Public products used by a wide group of individuals | Hospital beds, shopping trolleys, playground equipment | Interactive kiosks, ticket machines |
| | Transitional products used for a brief period of time | Gift wrapping, baby clothes, disposable toiletries, magazines | Musical gift cards, electronic toys |

**Table 8. Suitability of product categories for bespoke product design processes.**

### 7.5.6 Materiality has Inherent Meaning

Through our engagement with the world in which we live, we as humans develop meaningful relationships with things external to ourselves. Places, people, practices, experiences and objects aid us in characterising, communicating, maintaining and developing our self-identity (Belk, 1988). More recently, our relationships with digital media has similarly come to serve a role in these ongoing self-extension processes (Belk, 2013). Among these external things, material objects serve a unique role in reaffirming a person's sense of self. They bring clarity to one's self-understanding by providing tangible evidence of a person's closeness to their own mental image of an identity (Reed et al., 2012). A surfboard can reaffirm a person's perception of themselves as a laid-back beachgoer. A sculpture can signify a person's view of themselves as a cultured individual with good taste. A pair of runners can reinforce a person's perception of themselves as athletic and lively. Material objects enable us to better understand what we consider to be *me*, what we consider to be *not me* and what we wish for *me* to become (Kleine et al., 1995). The meaning of material objects as signifiers of identity are not limited to people's introspective views of themselves. We use rings to signify the love, commitment and union shared between married couples. Throne chairs have historically served as physical symbols of the high-status of a reigning monarch. The prevalence of material objects serving as symbols of a person's values, beliefs and status speaks to the inherent meaning of materiality in shaping our understanding of both ourselves and the world in which we live.

Our increasing adoption of digital technologies represents a transition in our engagements with material objects to immaterial media. While the research detailed within this thesis presents many ways in which our relationships with digital things fulfil many of the same self-developmental functions as our relationships with physical objects, the intangible nature of the digital medium creates certain limitations to the ability of digital possessions to provide affirmation and clarity to a person's understanding of themselves and their place within the world. This is reflected by the limited ability for digital possessions to be publicly displayed (Kirk & Sellen, 2010), to evoke feelings of pride (Brown & Sellen, 2006) and to provide a sense of ownership and control (Denegri-Knott et al., 2012; Odom et al., 2014).

The significance of material objects for humans extends beyond their role as tangible symbols. We as humans anthropomorphise objects, imbuing them with life and valuing them as *companions* with which we share significant moments throughout our lives (Battarbee & Mattelmäki, 2004), such as going on a road trip with a beloved car or hitting a home run with a lucky baseball bat. These objects are not just valued for the nonmaterial ideas they convey, but as independent *material entities* (Verbeek & Kockelkoren, 1998). This thesis has focused on the ways in which designers can create objects with associative meaning, yet it remains worth acknowledging the significance of materiality in itself as a means of engaging with the world around us. The development of emotional bonds between humans and objects remains an essential step in fostering a world in which people assign inherent value to matter and the material environment in which they live.

## 7.6 Directions for Future Research

Research conducted through this project was primarily explorative, considering new ways in which designers can create objects that are considered meaningful by users. Several of the themes raised through this exploration showed promise as worthwhile topics for further research but were beyond the scope of this thesis. In this section, we discuss a number of directions for future research related to the design of meaningful objects.

### 7.6.1 Object Associations

In Chapters 4, 5 and 6, several lists of concepts associated with certain objects were generated. These lists of associations often reflected the personal responses evoked by meaningful possessions, providing insight into the determinants of attachment. Our understanding of the ways in which people assign associative meaning to an object based on its aesthetic or functional properties remains limited. Our attempts to create objects with meaningful associations detailed in Chapters 4 and 6 were very much intuitive processes. Greater understanding of the ways in which people form associations to newly introduced objects could significantly improve the reliability and broaden the applicability of our proposed strategy for promoting product attachment.

### 7.6.2 Probe Methodology

In Chapters 3–6, we developed research tools and activities to facilitate conversations with our participants. These tools and activities were not universally applicable methodologies, but rather materials that were tailored to the research goals of specific projects. These probing methods played a fundamental role in developing new insights into product attachment, a heavily studied area of research. Further research exploring the epistemological value of facilitating interview-based methods of inquiry with tools and activities related to the objectives of the research project would broaden the scope of qualitative research to appropriately handle a variety of circumstances such as the discussion of sensitive topics or indistinct feelings.

### 7.6.3 Attachment and Detachment

The application of product attachment theory within design practice remains a difficult task. Existing research provides little guidance to the process of making things people will deem personally significant. While several design strategies derived from theory have been proposed (Golsteijn et al., 2012; Jung et al., 2011; Mugge, Schoormans, et al., 2005; Odom & Pierce, 2009; Schifferstein & Zwartkruis-Pelgrim, 2008) and even applied to design practice (Zimmerman, 2009), few studies have evaluated their effectiveness in promoting emotional value (Desmet et al., 2001; Lacey, 2009). Those that do attempt to evaluate the effectiveness of applied design strategies do so in a preliminary form, much like our own evaluations detailed in Chapters 4 and 6. The limited evaluation conducted in product attachment research is partly due to the difficulty of doing so with an apt level of control. Regardless, further research evaluating the emotional significance of products longitudinally would provide insights especially relevant to the sustainability objective of extending product lifetime. Longitudinal evaluations of designed or even existing products much like the work of Mugge, Schifferstein and Schoormans (2005a) would also provide greater insight into detachment, the process leading to the disposal of a product to which an individual once felt attached. In any attempts to design for lasting meaning, knowledge of the determinants for detachment are equally as valuable as insights related to the development of attachment. Insights into the process of detachment may also inform the development of new strategies and guidelines for promoting lasting product attachment.

### 7.6.4 Individuals in Need of Self-Extension

In Chapters 4 and 6, we designed, deployed and evaluated objects intended to contain meaningful associations for various individuals. The individuals participating in our research owned several possessions that they deemed significant prior to their involvement in our research. Further research could more directly address the need for meaningful objects by engaging with people who have recently faced a sudden loss of personal possessions that formed part of their self-identity (Belk, 1988; Wallendorf & Arnould, 1988). This sudden loss of possessions can occur systematically, through admission to an institution that severely restricts access to personal possessions, such as psychiatric hospitals, aged care homes, prisons, military training camps and boarding schools. It can occur unexpectedly, through being the victim of theft or natural disaster, such as a burglary, house fire, earthquake, flood or hurricane. It can also occur during life transitions, such as moving homes or going through a relationship breakup. The sudden loss of meaningful possessions often results in a *de-selfing* process (Tobin, 1996). People entering institutions in which personal possessions are replaced with standardised kits often face a loss of uniqueness (Snyder & Fromkin, 1980). Victims of theft or natural disaster often go through a process of grief similar to that in losing a loved one (Belk, 1988). Research focusing on the design of meaningful objects for the purpose of restoring a lost sense of self may provide applicable insight into the ways in which objects come to play a role in *self-extension* processes that underlie product attachment experiences.

# SUMMARY

## Designing Meaningful Objects

This doctoral thesis investigates the ways in which designers can create objects that are meaningful for their users. People develop strong emotional ties with objects for their role in characterising, communicating, maintaining or developing their own sense of self. They help us reaffirm and express who we were, who we are and who we wish to become. Promoting these emotional ties can aid in addressing sustainability issues with current rates of product consumption as people are reluctant to dispose of products they consider to be meaningful. This is especially relevant for the growing sector of technological products as they are less likely to evoke feelings of attachment and are often replaced far before their functional lifetime expires. Knowledge that sheds light on how designers may create products that are meaningful for users is valuable for manufacturers and society as a whole.

To explore ways in which product designers can promote meaningful human-object relationships through their practice, a series of empirical studies were conducted. The first study examined the relationship between meaningful objects and a person's self-identity. A number of probing activities were conducted in parallel with semi-structured interviews to frame meaningful objects in relation to several identity theory constructs. Findings showed that objects were primarily valued for their associations to meaningful events, relationships, achievements, life periods and values of the user. The second study explored how designers may create objects that relate to a person's self-identity. This was done by creating and evaluating a series of products inspired by the intended user's life story to facilitate the formation of personally significant associations. The process resulted in mixed levels of success in creating products which people ascribe meaning. These results were used to generate insight into appropriate means of designing for attachment through product design practice.

The physical-digital duality of technological products complicates the internal processes involved in ascribing meaning to a belonging. A study was conducted to investigate the relationship between everyday physical-digital products and a person's self-identity. Associations brought to mind by physical and digital components of a

product were compared. Digital components were often the primary source of meaning and material devices were perceived as important but replaceable. This revealed a number of unique characteristics of meaningful relationships between people and physical-digital products. The final study explored how designers may create physical-digital objects with meaningful, material links to a person's self-identity that reflect the construct of product attachment. This was done by creating and evaluating a bespoke interactive music player inspired by the intended user's personal ties to their digital music library. The results of this study reaffirmed the potential value of designing objects with meaningful associations as a strategy for promoting product attachment. The four cumulative studies provided input for the discussion chapter of this thesis, which provides an overview of the aforementioned strategy and considerations for designing meaningful objects, reflections on the processes and outcomes of each study and several directions for future research.

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# APPENDICES

## Appendix A: Study 1 Interview Guide

*Object Interventions*

- Comparison between existing and new routine objects
    - Preference between existing and new objects
        - Reasoning for this preference
    - Level of emotional attachment to the objects
    - Reasoning for rating of objects on scale of 'me' to 'not me'
- Frequency, duration and setting of use of the objects
- History of existing object
    - Time owned
    - Where it came from

*Identity Timelines*

- Objects listed on each timeline
    - Reasoning for being cherished
    - Relevance to their self-reported identity
- Probe for anything to add to timeline
- Change or lack of change of cherished objects over time
    - Elaborate upon the changes of certain objects of interest

# Appendix B: Study 1 Information and Consent Form

TU/e Technische Universiteit Eindhoven University of Technology

UNIVERSITY OF TECHNOLOGY SYDNEY

**INFORMATION SHEET**

Dear (participant's name),

My name is Daniel Orth and I am a post-graduate research student at UTS. My supervisor is Dr. Elise van den Hoven.

I would like to formally invite you to participate in a study of cherished possessions and the self, which is part of the Materialising Memories research project at UTS (HREC 2012000570). The Materialising Memories project is a collaboration between the University of Technology, Sydney and the Eindhoven University of Technology, The Netherlands.

This research will involve you engaging with a number of activities related to emotional attachment to possessions and their role in developing a sense of self. These activities include:
Integrating a number of products into your day-to-day routines for a 2 week period
Completing a set of self-reported 'identity timelines' about your most cherished possessions throughout your life
Mapping the movements of the cherished possessions revealed in the self-reported identity timelines
Discussing your responses to the above activities in the form of a 1-on-1 interview session

The information you provide will be analysed to generate insights into the reasoning for people's emotional attachment to certain possessions as well as the types of objects that are considered meaningful to their owner.

If you have any questions, please feel free to contact me by phone on [redacted] or by email at daniel.r.orth@student.uts.edu.au

Please remember that you are under no obligation to participate in this research. You can also decline from participating at any stage without penalty. Research data from this project may be published in a form that does not identify you in any way.

Yours sincerely,

Daniel Orth

**NOTE:**
The Human Research Ethics Committee of the University of Technology, Sydney has approved this study.

If you have any complaints or reservations about any aspect of your participation in this research, which you cannot resolve with the researcher, you may contact the following independent persons, who will treat your complaint or reservation in confidence, investigate it fully and inform you of the outcome.

When the researcher's primary affiliation is with the *University of Technology, Sydney*, you can contact: the Ethics Committee through the Research Ethics Officer (phone: +61 2 9514 9772, e-mail: Research.Ethics@uts.edu.au), at the University of Technology, Sydney. Please quote the UTS HREC reference number.

When the researcher's primary affiliation is with the *Eindhoven University of Technology*, you can contact: the Project Officer of the Industrial Design department at the Eindhoven University of Technology (ir. Karen Luijten-Hoffman, phone: +31 40 247 4772, e-mail: k.luijten.hoffman@tue.nl). Please quote the names of the project and researcher.

TU/e Technische Universiteit Eindhoven University of Technology

UNIVERSITY OF TECHNOLOGY SYDNEY

## CONSENT FORM

I _____ (participant's name) agree to participate in the research project Materialising Memories (Approval No. HREC 2012000570) being conducted by Daniel Orth (email: daniel.r.orth@student.uts.edu.au, mobile: [redacted]) of the University of Technology, Sydney for his Masters of Design (Research) degree. Funding for this research has been provided by UTS.

I understand that the purpose of this study is to gain insights into the emotional attachment formed with certain possessions.

I understand that my participation in this research will involve the use of a range of day-to-day objects over two weeks and the completion of an exercise involving personal timelines and mapping object movement. I understand that at the conclusion of this two week period, I will be asked to further discuss my responses to these prior activities in the form of a 1 on 1 interview session. I also understand that I may be asked for permission to take an audio recording or written notes of my comments during this interview session. I am entitled to refuse without any consequences if I do not want to have my comments recorded.

I understand that I have the option to not report anything I rather keep private during the two week study period nor am I obliged to further discuss any topics or responses that I am not comfortable sharing in the concluding interview session.

I am aware that I can contact Daniel or his supervisor, associate professor Dr. Elise van den Hoven, if I have any concerns about the research. I also understand that I am free to withdraw my participation from this research project at any time I wish, without consequences, and without giving a reason. I will not be penalised in any way for declining to take part in any stage of the research.

I agree that Daniel has answered all my questions fully and clearly.

I agree that the research data gathered from this project may be published in a form that does not identify me in any way.

_____ ____/____/____
Signature (participant)

_____ ____/____/____
Signature (researcher or delegate)

**NOTE:**
The Human Research Ethics Committee of the University of Technology, Sydney has approved this study.

If you have any complaints or reservations about any aspect of your participation in this research, which you cannot resolve with the researcher, you may contact the following independent persons, who will treat your complaint or reservation in confidence, investigate it fully and inform you of the outcome.

When the researcher's primary affiliation is with the *University of Technology, Sydney*, you can contact: the Ethics Committee through the Research Ethics Officer (phone: +61 2 9514 9772, e-mail: Research.Ethics@uts.edu.au), at the University of Technology, Sydney. Please quote the UTS HREC reference number.

When the researcher's primary affiliation is with the Eindhoven University of Technology, you can contact: the Project Officer of the Industrial Design department at the Eindhoven University of Technology (ir. Karen Luijten-Hoffman, phone: +31 40 247 4772, e-mail: k.luijten.hoffman@tue.nl). Please quote the names of the project and researcher.

# Appendix C: Study 2 Interview Guide

*Past life*

- Upbringing
    - Where
    - Fond memories
- Aspects of life
    - Lost over time
    - Continued over time
    - Recently grown

*Current life*

- Lifestyle
- Interests

*Future life*

- Ambitions
- Ways they hope to change or stay the same

*'Me' and 'Not Me'*

- Describing 'me' or things 'valued by me'
    - Personality traits (e.g. playful, sophisticated, honest)
    - Virtues (e.g. reliable, trustworthy, independent)
- Describing 'not me' or things 'not valued by me'
    - Personality traits (e.g. stern, submissive)
    - Virtues (e.g. social status, wealth)

*Emotional attachments*

- People
- Places
- Experiences
- Objects

*Relationships with objects*

- Aesthetic preferences (bring positive thoughts to mind)
    - Materials
    - Colours
    - Textures
- Sensory preferences
    - Sight
    - Sound
    - Scent
    - Taste
    - Tactile

*Object Associations*

- Types of objects that they often cherish
    - Reasoning
- Responses to cherished object associations
    - Reasoning
    - Meaningful
    - Mundane

# Appendix D: Study 2 Information and Consent Form

TU/e Technische Universiteit Eindhoven University of Technology

UNIVERSITY OF TECHNOLOGY SYDNEY

**INFORMATION SHEET**

Dear (participant's name),

My name is Daniel Orth and I am a post-graduate research student at UTS. My supervisor is Professor Dr. Elise van den Hoven.

I would like to formally invite you to participate in a design study of emotional attachment to objects and identity-based object associations, which is part of the Materialising Memories research project at UTS (HREC 2012000570). The Materialising Memories project is a collaboration between the University of Technology, Sydney and the Eindhoven University of Technology, The Netherlands.

This research will involve you engaging with a number of activities related to your self-identity, the design of objects and associations you may assign to objects in your life. These activities include:
Completing a number of 'Object Association cards' with associations that come to mind when interacting with an object
Discussing aspects of your self-identity such as valued experiences, memories, people, places and things as well as personal traits and preferences in the form of a 1-on-1 interview session
Integrating a number of products into your day-to-day routine for a 1 week period
Completing an evaluation of these products at the conclusion of the 1 week period in the form of a 1-on-1 debrief interview session

The information you provide will be analysed to generate insights into the influence of design on the formation of emotional attachment and object associations.

If you have any questions, please feel free to contact me by phone on [redacted] or by email at daniel.r.orth@student.uts.edu.au

Please remember that you are under no obligation to participate in this research. You can also decline from participating at any stage without penalty. Research data from this project may be published in a form that does not identify you in any way.
Yours sincerely,

Daniel Orth

**NOTE:**
The Human Research Ethics Committee of the University of Technology, Sydney has approved this study.

If you have any complaints or reservations about any aspect of your participation in this research, which you cannot resolve with the researcher, you may contact the following independent persons, who will treat your complaint or reservation in confidence, investigate it fully and inform you of the outcome.

When the researcher's primary affiliation is with the *University of Technology, Sydney*, you can contact: the Ethics Committee through the Research Ethics Officer (phone: +61 2 9514 9772, e-mail: Research.Ethics@uts.edu.au), at the University of Technology, Sydney. Please quote the UTS HREC reference number.

When the researcher's primary affiliation is with the *Eindhoven University of Technology*, you can contact: the Project Officer of the Industrial Design department at the Eindhoven University of Technology (ir. Karen Luijten-Hoffman, phone: +31 40 247 4772, e-mail: k.luijten.hoffman@tue.nl). Please quote the names of the project and researcher.

TU/e Technische Universiteit Eindhoven University of Technology

UNIVERSITY OF TECHNOLOGY SYDNEY

## CONSENT FORM

I _____ (participant's name) agree to participate in the research project Materialising Memories (Approval No. HREC 2012000570) being conducted by Daniel Orth (email: daniel.r.orth@student.uts.edu.au, mobile: [redacted]) of the University of Technology, Sydney for his Masters of Design (Research) degree. Funding for this research has been provided by UTS.

I understand that the purpose of this study is to gain insights into the influence of design on the formation of emotional attachment to certain objects.

I understand that my participation in this research will involve an interview session regarding aspects of my self-identity such as valued experiences, memories, people, places and things. I understand that my involvement will then include the use of a range of day-to-day objects over two weeks and an evaluation of these objects at the end of this two week period. I also understand that I may be asked for permission to take an audio recording or written notes of my comments during this interview session. I am entitled to refuse without any consequences if I do not want to have my comments recorded.

I understand that I have the option to not report anything I rather keep private during the study period nor am I obliged to further discuss any topics or responses that I am not comfortable sharing in the concluding interview session.

I am aware that I can contact Daniel or his supervisor, Professor Dr. Elise van den Hoven, if I have any concerns about the research. I also understand that I am free to withdraw my participation from this research project at any time I wish, without consequences, and without giving a reason. I will not be penalised in any way for declining to take part in any stage of the research.

I agree that Daniel has answered all my questions fully and clearly.

I agree that the research data gathered from this project may be published in a form that does not identify me in any way.

_____ ____/____/____
Signature (participant)

_____ ____/____/____
Signature (researcher or delegate)

**NOTE:**
The Human Research Ethics Committee of the University of Technology, Sydney has approved this study.

If you have any complaints or reservations about any aspect of your participation in this research, which you cannot resolve with the researcher, you may contact the following independent persons, who will treat your complaint or reservation in confidence, investigate it fully and inform you of the outcome.

When the researcher's primary affiliation is with the *University of Technology, Sydney*, you can contact: the Ethics Committee through the Research Ethics Officer (phone: +61 2 9514 9772, e-mail: Research.Ethics@uts.edu.au), at the University of Technology, Sydney. Please quote the UTS HREC reference number.

# Appendix E: Study 3 Interview Guide

*Overview*

Discuss thoughts that come to mind when engaging with tech devices

Study focuses on tech products that contain digital media (e.g. mobile phone)

1. Mobile phone = budget, girlfriend, Officeworks, nice feel
2. Music library = train rides, relaxing, broad
3. Frank Ocean song = lazy Sundays, chill out, European summer, boat

*Example Tech devices / digital collections / digital items*

- Smartphone | apps (e.g. social media), pictures, music, podcasts, games, messages
- Tablet | apps (e.g. social media), pictures, music
- Laptop | programs, pictures, music, documents, videos, messages, games / photo
- Desktop | programs, pictures, music, documents, videos, emails, games, bookmarks
- Storage (usb, hard drive, dvd) | pictures, videos, documents
- Games console | games (e.g. party games)
  - Digital camera
  - Video camera
  - E-book (kindle)
  - Smart TV
  - Smart watch
  - Fitness tracker (Fitbit)
  - Digital photo frame
  - MP3 player
  - Digital radio
  - Streaming device (Chromecast / AppleTV)
  - GPS

*Talking Points*

- Choice / selection of product
    - Gift / purchase
- Look / feel / personalised individual preferences
- Duration of ownership
- People / memories
- Importance in life
- Irreplaceable (e.g. wedding ring)

*'Meaningless' to 'Meaningful'*

- Thing vs what it provides (laptop capabilities vs replacement with newer model)
- Dealing with specifics (specific song / picture, specific laptop) not general category

# Appendix F: Study 3 Information and Consent Form

TU/e Technische Universiteit Eindhoven University of Technology

UNIVERSITY OF TECHNOLOGY SYDNEY

**INFORMATION SHEET**

Dear (participant's name),

My name is Daniel Orth and I am a doctoral student at UTS. My supervisors are Professor Elise van den Hoven and dr. Clementine Thurgood.

I would like to formally invite you to participate in a design study looking at the thoughts that come to mind when interacting with objects in the home, which is part of the Materialising Memories research project at UTS (HREC 2015000629). The Materialising Memories project is a collaboration between the University of Technology, Sydney and the Eindhoven University of Technology, The Netherlands.

This research will involve you engaging with three activities related to the associations you may assign to objects in your life. These activities include:
Completing a number of 'Association cards' with the thoughts that come to mind when interacting with devices and digital media
Discussing and evaluating the results of the 'Association cards' in the form of a 1-on-1 interview session
Rating the personal significance of the discussed devices and digital media

The total amount of time required for involvement in the study is expected to be 30 minutes. The information you provide will be analysed to generate insights into the differences between physical and digital products and their source of significance for individuals.

If you have any questions, please feel free to contact me by phone on [redacted] or by email at daniel.r.orth@student.uts.edu.au

Please remember that you are under no obligation to participate in this research. You can also decline from participating at any stage without penalty. Research data from this project may be published in a form that does not identify you in any way.

Yours sincerely,

Daniel Orth

**NOTE:**
The Human Research Ethics Committee of the University of Technology, Sydney has approved this study.

If you have any complaints or reservations about any aspect of your participation in this research, which you cannot resolve with the researcher, you may contact the following independent persons, who will treat your complaint or reservation in confidence, investigate it fully and inform you of the outcome.

When the researcher's primary affiliation is with the *University of Technology, Sydney*, you can contact: the Ethics Committee through the Research Ethics Officer (phone: +61 2 9514 9772, e-mail: Research.Ethics@uts.edu.au), at the University of Technology, Sydney. Please quote the UTS HREC reference number.

When the researcher's primary affiliation is with the *Eindhoven University of Technology*, you can contact: the Project Officer of the Industrial Design department at the Eindhoven University of Technology (ir. Karen Luijten-Hoffman, phone: +31 40 247 4772, e-mail: k.luijten.hoffman@tue.nl). Please quote the names of the project and researcher.

TU/e Technische Universiteit Eindhoven University of Technology

UNIVERSITY OF TECHNOLOGY SYDNEY

## CONSENT FORM

I _____ (participant's name) agree to participate in the research project Materialising Memories (Approval No. HREC 2015000629) being conducted by Daniel Orth (email: daniel.orth@uts.edu.au, mobile: [redacted]) of the University of Technology Sydney for his PhD thesis. Funding for this research has been provided by UTS.

I understand that the purpose of this study is to gain insights into the thoughts that come to mind when interacting with tech devices and their source of significance for individuals.

I understand that my participation in this research will involve listing my associations with devices, collections and digital media, an interview session discussing the results of this activity and an evaluation of the significance of the discussed products. I also understand that I may be asked for permission to take an audio recording or written notes of my comments during this interview session. I am entitled to refuse without any consequences if I do not want to have my comments recorded.

I understand that I have the option to not report anything I rather keep private during the study period nor am I obliged to further discuss any topics or responses that I am not comfortable sharing in the concluding interview session.

I am aware that I can contact Daniel or either of his supervisors, Professor Elise van den Hoven and dr. Clementine Thurgood, if I have any concerns about the research. I also understand that I am free to withdraw my participation from this research project at any time I wish, without consequences, and without giving a reason. I will not be penalised in any way for declining to take part in any stage of the research.

I agree that Daniel has answered all my questions fully and clearly.

I agree that the research data gathered from this project may be published in a form that does not identify me in any way.

_____ ____/____/____
Signature (participant)

_____ ____/____/____
Signature (researcher or delegate)

**NOTE:**
The Human Research Ethics Committee of the University of Technology, Sydney has approved this study.

If you have any complaints or reservations about any aspect of your participation in this research, which you cannot resolve with the researcher, you may contact the following independent persons, who will treat your complaint or reservation in confidence, investigate it fully and inform you of the outcome.

When the researcher's primary affiliation is with the *University of Technology, Sydney*, you can contact: the Ethics Committee through the Research Ethics Officer (phone: +61 2 9514 9772, e-mail: Research.Ethics@uts.edu.au), at the University of Technology, Sydney. Please quote the UTS HREC reference number.

# Appendix G: Study 4 Interview Guide

## Interview 1: Identity Narrative

*Life History*

- Upbringing
    - Location, fond memories, interests, personality
    - Interests (sport, school, music)
    - Teenager
    - Interests (sport, school, music, movies)
    - Personality, memories, experiences
- Young Adulthood
    - Engagements (work, social)
    - Fond memories / experiences
    - Interests / activities (travel?)
- Mid Adulthood
    - Engagements
    - Interests / activities
- Current
    - Lifestyle
    - Interests / activities
- Aspects lost / continued / grown over time
- Future
    - Ambitions
    - Hopes for change / continuity

*Music History*

- First genre / period getting into music
    - Listening experiences / memories
- Developments / enhancements over time
- Additional genres / periods / experiences
    - Live gigs, social situations, playing an instrument
- Memorable music experiences / recurring activities throughout life

- Aspects of life encompassed by music (e.g. family, work, health, social, travel)

*Personality and Virtues*

- Personality traits (e.g. playful, sophisticated, honest - NOT stern, submissive)
- Virtues (e.g. reliable, trustworthy, independent – NOT social status, wealth)
- Personality / virtues reflected by relationship with music

## Interview 2: Musical Experiences

*General*

- Aesthetic preferences (bring positive thoughts to mind)
    - Materials
    - Colours
    - Textures
- Sensory preferences
    - Sight
    - Sound
    - Scent
    - Taste
    - Tactile
- Printed Materials
    - Music posters
- Emotional attachments
    - People
    - Places
    - Experiences
    - Objects (types / reasoning)
- Associations
    - Associations of relationship with music (collectively)
    - Aspects of self that are represented / reflected by music
- Spotify / Music library
    - Playlists
    - History

    - Artists
    - Albums

*Categories*

- Grouping (playlists)
    - Different ways to categorise the music library
        - genre, activity, mood, time period
        - e.g. “running”, “family road trip”, “live gigs youth”, “live gigs revival”, “discovery”, “bass player”
    - post it notes / Spotify / iTunes
- Association Cards
    - Associations of each developed category
        - emotions, qualities, values, beliefs, activities
    - Aspects of self that are represented by each category

*Properties*

- simple ←→ complex
- excited ←→ calm
- messy ←→ ordered
- abstract ←→ concrete
- familiar ←→ different
- jagged ←→ curved
- soft ←→ hard
- light ←→ heavy
- vivid ←→ subdued
- colourful ←→ muted
- personal ←→ social
- past ←→ future

*Setting*

- Listening
    - Location
    - Context
    - Activities
- Speaker system (aux vs Bluetooth)
- Stream vs download
- Music collection
    - Records

## Interview 3: Materialising Musical Media

*Experience*

- Thoughts on product
- Experiences from using the device
    - Listening experience vs normal methods

*Associations for each object*

- Object Association cards
- Thoughts that led to listed associations

*Comparative Ratings*

- Me vs Not Me
- Authentic vs Inauthentic
- Meaningful vs Meaningless
- Reasoning for responses

*Process*

- Initial expectations
- Early interviews
- Design activities
- Mood boards
- Testing

# Appendix H: Study 4 Information and Consent Form

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**PARTICIPANT INFORMATION SHEET**
**MATERIALISING MEMORIES (HREC 2015000629)**

WHO IS DOING THE RESEARCH?

My name is Daniel Orth and I am a PhD student at UTS. My supervisors are Professor Elise van den Hoven (elise.vandenhoven@uts.edu.au) and Dr. Clementine Thurgood (c.thurgood@swin.edu.au).

WHAT IS THIS RESEARCH ABOUT?

This research is a design study looking at the thoughts that come to mind when interacting with personal music collections and objects in the home. It intends to explore ways in which designers can create objects that embody the personal thoughts that come to mind when interacting with media such as music. The study is a part of the Materialising Memories research project at UTS (HREC 2015000629).

FUNDING

This research is supported by an Australian Government Research Training Program Scholarship.

WHY HAVE I BEEN ASKED?

You have been invited to participate in this study because of your suitable level of engagement with a personal music collection.

IF I SAY YES, WHAT WILL IT INVOLVE?

If you decide to participate, I will invite you to be involved in the process of designing a number of personalised objects that intend to reflect the memories, experiences and emotions you associate with your personal music library. This process will include the following activities:
A series of semi-structured interviews, discussing the thoughts that come to mind when engaging with your personal music library and your preferences and associations of various material properties such as texture, shape and colour. These interviews will be audio recorded and transcribed.
Collaborative design sessions discussing and appraising a range of ideas and concepts that are intended to reflect the meaning of your personal music library
Integrating the resulting designed music players into your day-to-day routine for a 2 week period
Completing an evaluation of these music players at the conclusion of the 2 week period in the form of a 1-on-1 debrief interview session

ARE THERE ANY RISKS/INCONVENIENCE?

Yes, there are some risks/inconvenience. You may be asked sensitive questions about your personal experiences related to your music collection. You are entitled to not reveal any information you do not feel comfortable discussing. The intention of interviews is to discuss the positive memories and associations you have formed.

DO I HAVE TO SAY YES?

Participation in this study is voluntary. It is completely up to you whether or not you decide to take part. project and it will only be disclosed with your permission, except as required by law.

We plan to publish the results in a research paper. In any publication, information will be provided in such a way that you cannot be identified.

Technische Universiteit Eindhoven University of Technology

UNIVERSITY OF TECHNOLOGY SYDNEY

**PARTICIPANT INFORMATION SHEET**
**MATERIALISING MEMORIES (HREC 2015000629)**

WHAT WILL HAPPEN IF I SAY NO?

If you decide not to participate, it will not affect your relationship with the researchers. If you wish to withdraw from the study once it has started, you can do so at any time without having to give a reason, by contacting Daniel on mob.: [redacted] or email: daniel.orth@uts.edu.au

If you withdraw from the study, all transcripts, audio recordings and other research materials generated from your involvement will be destroyed.

CONFIDENTIALITY

By signing the consent form you consent to the research team collecting and using personal information about you for the research project. All this information will be treated confidentially. Your contribution to the study will be kept anonymous with research data collected from this project presented in a form that does not identify you in any way. Your information will only be used for the purpose of this research project and it will only be disclosed with your permission, except as required by law.

We plan to publish the results in a research paper. In any publication, information will be provided in such a way that you cannot be identified.

WHAT IF I HAVE CONCERNS OR A COMPLAINT?

If you have concerns about the research that you think I or my supervisors can help you with, please feel free to contact me on [redacted] or email: daniel.orth@uts.edu.au.

**NOTE:**
The Human Research Ethics Committee of the University of Technology, Sydney has approved this study.

If you have any complaints or reservations about any aspect of your participation in this research, which you cannot resolve with the researcher, you may contact the following independent persons, who will treat your complaint or reservation in confidence, investigate it fully and inform you of the outcome.

If you have any concerns or complaints about any aspect of the conduct of this research, please contact the Ethics Secretariat on ph.: +61 2 9514 2478 or email: Research.Ethics@uts.edu.au], and quote the UTS HREC reference number. Any matter raised will be treated confidentially, investigated and you will be informed of the outcome.

When the researcher's primary affiliation is with the University of Technology Sydney, you can contact: the Ethics Committee through the Research Ethics Officer (phone: +61 2 9514 9772, e-mail: Research.Ethics@uts.edu.au), at the University of Technology Sydney. Please quote the UTS HREC reference number.

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UNIVERSITY OF TECHNOLOGY SYDNEY

**CONSENT FORM**
**MATERIALISING MEMORIES (HREC 2015000629)**

I _____ (participant's name) agree to participate in the research project Materialising Memories (Approval no. 2015000629) being conducted by Daniel Orth (daniel.r.orth@student.uts.edu.au) of the University of Technology Sydney as part of his PhD thesis. I understand that funding for this research has been provided by the University of Technology Sydney with scholarship support provided by the Australian Government Research Training Program.

I have read and understand the Participant Information Sheet.

I understand the purposes, procedures and risks of the research as described in the Participant Information Sheet.

I have had an opportunity to ask questions and I am satisfied with the answers I have received.

I freely agree to participate in this research project as described and understand that I am free to withdraw at any time without affecting my relationship with the researchers or the University of Technology Sydney.

I understand that I will be given a signed copy of this document to keep.

I agree to be:

☐ Audio recorded

I agree that the research data gathered from this project may be published in a form that:

☐ Does not identify me in any way

I am aware that I can contact Daniel Orth (daniel.r.orth@student.uts.edu.au), Prof. Dr. Elise van den Hoven, MTD (Elise.VandenHoven@uts.edu.au, +61295148967) or Dr. Clementine Thurgood (c.thurgood@swin.edu.au) if I have any concerns about the research.

_____ ____/____/____
Name and Signature (participant) Date

_____ ____/____/____
Name and Signature (researcher or delegate) Date

**NOTE:**
This study has been approved by the Human Research Ethics Committee of the University of Technology Sydney.

If you have any complaints or reservations about any aspect of your participation in this research, which you cannot resolve with the researcher, you may contact the following independent persons, who will treat your complaint or reservation in confidence, investigate it fully and inform you of the outcome.

When the researcher's primary affiliation is with the *University of Technology, Sydney*, you can contact: the Ethics Committee through the Research Ethics Officer (phone: +61 2 9514 9772, e-mail: Research.Ethics@uts.edu.au), at the University of Technology, Sydney. Please quote the UTS HREC reference number.

When the researcher's primary affiliation is with the *Eindhoven University of Technology*, you can contact: ir. Karen Luijten-Hoffman (phone: +31 6 3360 4020, e-mail: k.luijten.hoffman@tue.nl) at the TU/e Innovation Lab, Eindhoven University of Technology. Please quote the names of the project and researcher.

# LIST OF PUBLICATIONS

Orth, D., Thurgood, C., & van den Hoven, E. (2018). Designing objects with meaningful associations. *International Journal of Design, 12*(2), 91–104.

Tsai, W. C., Orth, D., & van den Hoven, E. (2017). Designing memory probes to inform dialogue. In *Proceedings of the 2017 Conference on Designing Interactive Systems* (pp. 889–901). New York, NY: ACM.

Orth, D., & van den Hoven, E. (2016). "I wouldn't choose that key ring; it's not me": A design study of cherished possessions and the self. In *Proceedings of the 28th Australian Conference on Computer-Human Interaction* (pp. 316–325). New York, NY: ACM.

van Gennip, D., Orth, D., Imtiaz, M.A., van den Hoven, E., & Plimmer, B. (2016). Workshop on Tangible cognition: Bringing together tangible interaction and cognition in HCI. In *Proceedings of the 28th Australian Conference on Computer-Human Interaction* (pp. 662–665). New York, NY: ACM.

# CURRICULUM VITAE

Daniel Orth is a PhD candidate in the Materialising Memories research program at the University of Technology Sydney. He previously obtained a bachelor's degree in Industrial Design at the University of Technology Sydney. His research focuses on designing for product attachment and the intersection between physical and digital products. He has presented his research at several international conferences and published in the International Journal of Design. Daniel has also worked extensively as an industrial designer, developing award winning design solutions with a range of global retail brands including Revlon, Unilever, Energizer and Elizabeth Arden. He also teaches design at the University of Technology Sydney in courses related to emotional design, user-centred design, product sustainability and design research.