Design-oriented HCI through Postphenomenology

by

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Abstract

This doctoral dissertation presents a reflexive account of a design researcher exploring a way to complement human-centered approaches in design-oriented Human-Computer Interaction (HCI) through postphenomenology. This endeavour is based on the possibility that human-centeredness in HCI may obscure aspects of the understanding of humans, technology, and the relations that come about between them. Postphenomenology, a contemporary strand of the philosophy of technology, seems to offer a holistic view and conceptualizations that can deepen an understanding of the human and the many different kinds of relations that can emerge with technology in the context of HCI.

Motivated by this, the objective of this dissertation is to explore how postphenomenology can contribute a holistic perspective on human-technology relations that can help complement and expand human-centered approaches to design research and practice. To address this, postphenomenology is introduced as a novel analytical framing. Then, two cases of reflective design research practice are presented that illustrate how postphenomenology can be of value as a productive analytical lens by using it: (i) to retrospectively analyze an empirical design ethnography study of guide dog teams, and (ii) to analyze a Research through Design (RtD) deployment study of the table-non-table. In addition to that, to provide a vertical grounding of this research and scaffolding for future research opportunities an analysis of a range of prior RtD projects through the lens of postphenomenology is synthesized in an annotated portfolio.

What is revealed in design-oriented HCI through postphenomenology, as demonstrated in this dissertation, is a holistic perspective on the matters concerning the field of HCI that can be complementary to previous ways of understanding. Postphenomenology opens up a view of the human that in one way decenters the human and puts technology and the mediating effect of technology at the center. In this, the human, still a central concern, is understood as technologically mediated. This perspective overcomes a narrow view of the human present in human-centered approaches and it can help HCI researchers get a holistic view of the human while taking into account the relations that in fact 'make' the human.

Keywords: human-technology relations; postphenomenology; reflective design research practice; field work; human-animal relations; posthumanism

To dogs and their mediating effects

To *Finja*, from who I learned my biggest life lessons and
who made me who I am. I miss you always.

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Chapter 1.

Introduction

Understanding the relations between technologies and humans as *interactions* has been foundational to the establishment and development of the field of Human-Computer Interaction (HCI). Having its roots in engineering and cognitive science, for decades a primary aim of HCI has been to optimize the fit between computational systems and humans. With that in mind, the relation between systems and humans has mostly been approached in terms of interactivity: the human performs an action and the system responds; the cycle continues until a task is accomplished. The main goal of this approach aimed to support efficient task completion—and, for good reason. This approach has strongly influenced the development of the field of *interaction design*, a core subfield of HCI concerned with understanding and shaping human interactions with technologies for the better. As technologies increasingly became part of people's everyday life and leisure time, focus expanded beyond the office and a need for alternative sets of values to guide the design of technology for everyday life grew (e.g., Nelson & Stolterman, 2012). Subsequently, more emphasis was put on understanding the complexity of everyday life, considering emotions, experience, values, and the context outside of the office. New frameworks for understanding human *interaction* (Dourish, 2001) and human *experience* (McCarthy & Wright, 2004) have been providing an important foundation for these developments.

With a central focus on the *interactions* between humans and technology, Human-Computer Interaction (HCI) has been permeated by *human-centered* ways of thinking and doing when engaging in designing technology for *human users* and aspects of their everyday lives. In recent years, work has started to emerge that brings forward the possibility of reconsidering this perspective.

For example, *interactions* may just be one of many possible *relations* that can come about between humans and technologies (Verbeek, 2015). Today we can find examples of technologies and products that may be tangible and embodied, while also becoming invisible when used (e.g., activity trackers); capture aspects of our life experiences which we then interpret and that implicitly or explicitly influence us (e.g., Instagram); contain a certain agency that spans across and changes through use or non-use (e.g., Google Home, or a self-directed

automated ordering system as part of the Internet of Things); or, move into the background and become obscured from our active notice—at least most of the time (e.g., Nest, Google Home when not in direct use).

Broadly speaking, from these examples we can see that a human-centered design perspective is shaped by the idea that a human is positioned with autonomous agency and, through this, has an independent intentionality towards technology. In this perspective, humans have goals and intentions, and products help them to realize these in an optimal or even in a fun, embodied, slow, or rich way. In many cases, however, these goals and intentions do not exist independently from the technologies that are used. For instance, an iPhone allows people to call, message, check the news or emails, but it has also generated new patterns and expectations around communication; thus, it has far exceeded purely being instrumental and has had a profound shaping effect on our goals and intentions.

Collectively, these examples help show how human-centeredness may obscure aspects of the understanding of humans, technology, the relations that come about between them, and the qualities of those relations. A human-centered way of approaching the design of technology for everyday life may not account for the wide range of relations that humans have with technology (cf. Fallman, 2011). This points towards an opportunity for HCI to engage with a deeper understanding of the relations between humans and technology to complement its existing approaches.

Recent developments and insights from the philosophy of technology, specifically from its contemporary and rapidly growing postphenomenological strand, bring forward ways to rethink the relations between humans and things, and subsequently the way humans and technology can be understood. For example, postphenomenology presents the idea of understanding technologies as *transformative mediators* of human-world relations rather than separated functional, instrumental objects or alienating entities (Verbeek, 2005). Technologies mediate humans' experiences and perceptions in and of the world as it is to the human. Through *technological mediation*, humans and technology mutually shape each other in the relations that come about between them. In that respect, agency is distributed across the human and technology and intentionality is viewed as inherently mediated. The human is no longer understood as an autonomous agent. In postphenomenological studies, concrete case examples of technologies are investigated in terms of the relations humans have with them and several potential sets of bodily-perceptual human-technology relations are considered. For

instance, technology could be encountered as an *embodiment*, as an *alterity*, through a *hermeneutic*, or a *background* relation.

This presents a diverse and holistic view that considers the human and the many different kinds of relations that can emerge with technology. From a postphenomenological perspective, this philosophical lens could potentially offer conceptualizations of the relations between humans and technologies that can deepen an understanding of what 'interaction' means in the context of HCI (cf. Verbeek, 2015).

Thus, when considering a postphenomenological perspective in the context of the HCI community, one can ask: *Could postphenomenology contribute a holistic perspective on human relations with technology that can help complement and expand human-centered approaches to design research and practice?*

Motivated by this overarching question, as an HCI design researcher, it is my goal to conduct an investigation exploring what a postphenomenological perspective might hold in complement to human-centeredness. I addressed this research objective in two ways: first, by drawing on two cases of my own design research practice—(a) the studying of guide dog teams and (b) the field deployments of the table-non-table—which both in their own way challenge aspects of human-centeredness; and second, through the use of postphenomenology as an analytical lens to study and analyze these cases.

Through this explorative inquiry, I investigate the following research questions:

1) *Can postphenomenology provide the design-oriented HCI community with a valuable holistic view of human-technology relations in complement to human-centered approaches?*

2) *What is revealed about human-technology relations when postphenomenology is utilized within design-oriented HCI research?*

In my exploratory and reflective design research approach, I will adopt a position of advocacy for postphenomenology. From this position, I aim to explore what the holistic and comprehensive perspective of postphenomenology offers to my practice efforts in design-oriented HCI.

1.1. Contribution, Audience and Overview

This dissertation offers two core contributions to advance design-oriented HCI research. First, it introduces postphenomenology as a novel analytical framing showing how it can complement design-oriented HCI research beyond purely human-centered approaches. Second, this dissertation contributes two cases of reflective design research practice that illustrate how postphenomenology can be of value as a productive analytical lens by using it: (i) to retrospectively analyze an empirical design ethnography study of guide dog teams, and (ii) to analyze a Research through Design (RtD) deployment study of the table-non-table. In addition to that, to provide a vertical grounding of this research and scaffolding for future research opportunities an analysis of a range of prior RtD projects through the lens of postphenomenology is synthesized in an annotated portfolio.

This work will primarily be of interest to the design-oriented HCI community. It is particularly valuable to design researchers who are interested in investigating how technologies mediate people's everyday experiences and actions in the world. This work will also hold value for design researchers interested in theoretical advancements in HCI design research practice and more broadly the field of HCI. Secondarily, this work offers interesting and novel research case examples to postphenomenologists that can add to the body of case studies and also provide new perspectives.

This dissertation consists of eight chapters.

Chapter 1 introduced the topic of this work and what it is motivated by. It also described the research objective and contribution.

Chapter 2 discusses related works, grounding and motivating the research presented in this dissertation. These works mainly come from the field of HCI (particularly design-oriented HCI) and also Philosophy of Technology, particularly postphenomenology, as it is the chosen theoretical framework I utilize in my research.

Chapter 3 details the methodological and epistemological commitments of this research, which is a reflexive account of a design researcher integrating postphenomenology as an analytical lens to complement human-centeredness in the context of design-oriented HCI. This research is of qualitative nature; it is creative, exploratory, and relying on a 'researcher-designed framework' that is unique to this dissertation.

Chapter 4 presents the first research case, the analysis of a design ethnography *studying guide dog teams* using postphenomenology as an informing theoretical lens. This analysis is retrospective and leverages an originally human-centered study. Ultimately, the two approaches to studying guide dog teams are contrasted.

Chapter 5 presents the second design research case, the *Field Deployments of the table-non-table*. In this case the analytical lens of postphenomenology is introduced mid-way throughout the field deployments performing another deployment informed by the theoretical framework. In comparison to the first case, this case presents a progression rather than the contrasting of two approaches.

Chapter 6 discusses the collective findings of the two cases and turns to answering the main research questions. This is done first by discussing lessons learned from the two research cases respectively, and second, by introducing insights for HCI based on postphenomenological notions of human-technology-world relations and related concepts.

Chapter 7 generalizes some of the research findings of this dissertation through a vertical grounding exercise extending the conceptualization of the table-non-table *as a postphenomenological inquiry* towards generating a synthesized analysis of six other contemporary RtD projects in an annotated portfolio. This opens up new ways of looking at these generative works and provides a scaffolding for future research opportunities. Additionally, this chapter discusses how this work can be of value to and extend the field of postphenomenology.

Chapter 8 concludes this work by providing a thorough summary and by illustrating how the research questions were addressed. Furthermore, how this research can be seen as a posthumanist exploration in the context of HCI is discussed as an avenue for future work.

1.2. Personal Background and Motivation of this Dissertation

At the end of this introduction I would like to take the opportunity to give some insight into what motivated me to do this research over the course of the last six years (2012-2018). The content of this dissertation is informed by my personal background and interest as well as by my evolving academic interest and the consecutive desire to merge postphenomenological considerations into my design practice and design research methodology. This desire has become a focal point in my development as a design researcher and also in this dissertation. It was sparked by works of philosopher Peter-Paul Verbeek whose work directly links postphenomenology, technological mediation, and design (e.g., Verbeek 2005). In this section I briefly describe more details about my personal background and motivation. I also give brief insight into my two research projects that have directly informed this dissertation shaping a consequential overarching evolution of thinking.

I came to do my PhD without much experience in HCI design research. I had previously done a Diplom in 2007 (German degree comparable to a BSc. Hon.) in information science at a university of applied sciences (Hochschule Darmstadt) and a Masters in Design in 2009 at a design university (Hochschule für Gestaltung Schwäbisch Gmünd). Both degrees were largely practice based and applied. I had additionally worked in the interaction design department of a small design university in a management position while also being involved in curricular development and general evolvement of the program.

At the beginning of my PhD studies in 2012 I took a course on qualitative research methods with my advisor Carman Neustaedter. In this class I had to conduct a study with a participant group. I chose to do this with guide dog users. I love dogs. I grew up with dogs and at the age of eight got my first own dog. Ever since then, building a strong relationship to dogs (and also other animals) and being actively involved in training as well as breeding dogs has been a big part of my life. On a daily basis, I am part of and reflect on human-dog relationships and more broadly human-animal relationships. As a result, I have for example since 2010 largely been adopting a plant-based diet. Naturally, guide dogs (and other assistance dogs) have been fascinating to me. When I learned about interaction design throughout my Masters and subsequent job I had actually started wondering whether interaction design interventions could maybe enhance the abilities of guide dogs for their users in a meaningful way. Therefore, it felt natural to propose studying guide dog users for my course project.

I conducted a pilot study interviewing and observing six guide dog handlers for my course work. I later extended the study and was able to publish my first full conference paper as a first author (Hauser, Wakkary, & Neustaedter, 2014). This study of guide dog teams was a starting point in my work as a PhD student. In this dissertation, it also serves as a starting point and as a unique and fit case example that was selected to be re-analyzed using postphenomenology as a lens (see Chapter 4). This was however not decided until years later (in Fall 2016) but rather happened organically alongside my academic development.

Nearly simultaneously when I conducted my studies of guide dog teams, I participated in a research project of my research group in the Everyday Design Studio applying concepts from theories of social practices to our observations of practices of Green DIY and to future design approaches (Wakkary, Desjardins, Hauser, & Maestri, 2013). This project introduced me to using theoretical work from other fields in the practice of design research. It also lead our research group to a subsequent explorative design creation of a research artifact called the *table-non-table* – an unfamiliar digital thing that is not determined by its function but asking to become a resource of everyday practices of home dwellers (Wakkary, Desjardins, & Hauser, 2015; Wakkary, Odom, Hauser, Hertz, & Lin, 2015). I participated in the design process of the table-non-table in 2012-2013 and subsequently took on the lead of a series of deployment studies (guided by my supervisor) over the course of four years (2013-2017). This project and study became a major part of my dissertation work (see Chapter 5).

In parallel to conducting the earlier field deployments with the table-non-table, in 2013 and 2014, I helped my supervisor organize the 2014 ACM conference on Designing Interactive Systems (DIS) which he was co-chairing and we were hosting in Vancouver, BC, Canada in June 2014. Through this assistantship, I had the opportunity to meet philosopher of technology Peter-Paul Verbeek, who we had invited as a main keynote speaker. Verbeek's keynote talk inspired me to look closer into how his work could further relate to my future work. His work had already caught my interest previously as it relates a deep understanding of technology and humans directly to the work of designers and a few selected works in HCI had cited his work (e.g. Odom et al., 2009). At this time, I was in the process of putting together my 'Annotated Bibliography'[1] looking into many HCI papers that caught my interest. I ended up exploring the

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[1] An 'Annotated Bibliography' is a milestone in my PhD program that students have to fulfil. It is a comprehensive selection of 80-120 works of literature that are summarized by the student. Ideally, this milestone allows for exploring different areas of research that are interesting to the student and will help with forming the dissertation topic and a part of the dissertation's literature review work.

bringing together of interaction design research or design-oriented HCI research with Verbeek's and other philosopher's work within the philosophy of technology through my annotated bibliography in the Fall of 2014. Subsequently, I successfully passed my 'Comprehensive Exam'[2] in December 2014 on questions around Human-Technology Relations and design-oriented HCI research and also defended my PhD proposal in March 2015 which had an overarching guiding goal of bridging contemporary works of the philosophy of technology namely *postphenomenology* and design-oriented HCI. With my proposal done I reached out to Peter-Paul Verbeek to get him involved in my doctoral research as a supervisor which he agreed to.

Through the collaboration with and guidance by Peter-Paul Verbeek and also thoroughly studying his works and more generally postphenomenology, I further established my dissertation research. The contemporary tradition of thought within philosophy of technology aims to understand 'the social and cultural roles' technology plays in 'human existence and experience' by investigating the relations humans can have with technologies and how those relations shape humans and their being in the world (Verbeek, 2005). Studying postphenomenology made me think more deeply about human's relations with technology and also consider the designer's role in this and how I as a researcher could incorporate this thinking more in my work. It seemed to take a critical standpoint towards technology yet also embracing innovation that spoke to me. It also lead me to re-think some of the previous work I had done and also the work that I was doing at the moment which directly informed my dissertation. For example, I looked back at the ways I had deployed the table-non-table yet with postphenomenological considerations. Similarly, I thought about what I had learned about guide dog teams and saw a connection between technological mediation and the mediation of guide dogs as non-humans in their handler's lives.

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[2] Similar to the Annotated Bibliography, the Comprehensive Exam and Proposal are milestones in my PhD Program. The former is a 4-week exam with three questions which are based on the Annotated Bibliography to be answered in two essays and one oral presentations. The latter is a written proposal submission and subsequent presentation to the committee.
For further information see also the program's website under http://www.sfu.ca/students/calendar/2018/ fall/programs/ interactive-arts-and-technology/doctor-of-philosophy.html

Chapter 2.
Related Works

In this chapter, I discuss works related to and grounding this dissertation's research. Related works mainly come from the field of HCI (particularly design-oriented HCI) and also the philosophy of technology, particularly postphenomenology, as it is the chosen theoretical framework I utilize in my endeavours. I will discuss how the two fields can be productively combined to approach possible limitations of human-centeredness in design-oriented HCI.

2.1. Human-Centeredness in HCI[3]

The field of Human-Computer Interaction (HCI) research has gone through paradigmatic changes since its early beginning in the 1980s. Three paradigms[4] (Harrison, Tatar, & Sengers, 2007), or what Bødker (2006) calls waves, have been described. In what follows, I will briefly discuss each paradigm and specifically aim to detail how the human has been approached in each one of them. Importantly, the three paradigms should not be seen as being better than or disproving the previously established paradigm; rather they can co-exist and provide alternative ways of thinking (cf. Bardzell & Bardzell, 2015). All paradigms can be seen as fostering human-centeredness; however, works moving beyond human-centeredness can find their place in the third paradigm or third wave HCI.

Highly influenced by having its roots in engineering research, the *first paradigm* fostered investigations into performances of humans with complex information systems such as pilots interacting with airplane control systems. An emphasis was put here on single human users operating a single application or system. *Human factors and ergonomics* aimed to clarify the interaction between human and system and were an attempt to reduce human errors and increase productivity and safety in the design of information systems. This combination of

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[3] Please note that for the purpose of keeping with the scope of the dissertation this is a simplified description of the development of the human-centered or humanistic perspective and way of approaching in HCI as well as the underlying influences on epistemological and methodological commitments. A thorough and more elaborate overview can be found for example in (Bardzell & Bardzell, 2015)

[4] The use of the term paradigm is based on Kuhn's notion of paradigms (Kuhn, 1962)

engineering and human factors "saw interaction as a form of man-machine coupling in ways inspired by industrial engineering and economics" paradigms (Harrison et al., 2007, p. 4). It was the aim within this paradigm to "optimize the fit between humans and machines" (Harrison et al., 2007, p. 4). The human or the human mind was seen as an information processor.

The *second paradigm* was coined by a 'cognitive revolution' through which cognitive science approaches were adopted in explorations into the idea that human information processing can be seen as symmetric to computational information processing. The main goal was to enable productive and efficient communication between the human and the system in *use*. The emphasis was put on human-machine interaction in a work context and particularly evolved into improving human teams' collaboration and using a variety of applications in a work setting which also coined the development of Computer-Supported Cooperative Work (CSCW) as a major research strand. Humans were seen as users or workers with a particular practice and in a particular setting (cf. Bødker, 2006). Technology in this and the first paradigm was seen as a means to complete or accomplish well-defined tasks.

As technology over the years moved more and more into people's everyday life, issues arose with the applicability of the second paradigm. The *third paradigm* signified the move from trying to support the efficiency of work tasks and human-technology interactions towards a better understanding and targeting of human-technology interactions in an everyday life context. Emerging strands of HCI research developed such as participatory design, value-sensitive design, user experience design, ethnomethodology, embodied interaction, interaction analysis, and critical design, which all poorly fit into the two earlier paradigms. In this new paradigm interaction was seen as "phenomenologically situated" (Harrison et al., 2007). An emphasis was put on human interaction with technology situated within everyday settings, "in which all action, interaction, and knowledge is seen as embodied in situated human actors" (Harrison et al., 2007, p. 7). This illustrates a standing central focus on the human. The central aim coming out of this paradigm is to design usable products and systems and effective user experiences situated within a context of humans' everyday lifeworld. *User experience design* finds its origins in this paradigm. Additionally, a key interest emerging from this paradigm for HCI research is also to better understand humans' abilities and behaviours for the sake of designing better technological interventions for them.

Interaction design research, a relatively young but growing field within HCI research, established itself as the more design-oriented account of HCI research. With the shift in focus of

the *third paradigm* design practice and design practitioners increasingly became part of the HCI research field and community. Generally, interaction design is concerned with shaping technologies for humans. In this, a central focus traditionally in this field has been on *human interaction with technology* and understanding interaction as a dialogue. Technologies or products are designed to be interacted with in a *useful* matter (or *used*). Hence, in interaction design practice and research the main qualities of human-technology interactions considered are typically based on notions of functionality and usability. In this, the human is viewed as a *user* or *experiencer* and the technology through notions of instrumentality.

Collectively, understanding and influencing interactions between humans and computers has been a key goal and foundation for the establishment and development of the field of HCI. This has led to important developments and innovations and will continue to do so. However, the field has been permeated by human-centered, humanistic (cf. Bardzell & Bardzell, 2015) or anthropocentric ways of thinking engaged in the designing and accounting for human use of technology. In what follows, I will discuss possible limitations and shortcomings of this human-centered focus that HCI works traditionally and largely tend to focus on.

2.1.1. Possible Limitations and Shortcomings of Human-Centeredness[5]

Human-centered ways of approaching HCI research and practice can be seen as possibly implying a narrow view and understanding of the human and the technology (i.e., the entities at play in human-technology relations) and the relations that can come about between them (interactions, intersections, connections, or other engagements) as well as the qualities to those relations (cf. Fallman, 2011; Verbeek, 2015; Wakkary & Odom, 2018).

Specifically, human-centered approaches to studying and influencing people through design research in HCI traditionally entail a focus on *interaction* and engineered experiences as the central view of the relation between humans and technology. The *human* is traditionally viewed as a *user* or *experiencer* based on a limited set of perceptions, actions, and values; and *technology* is further viewed considering mostly its direct value towards the human user based

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[5] An important remark I would like to make at this point is that in this dissertation I will view **human-centeredness in design-oriented HCI** as human-centered (humanistic) ways of approaching, which I see as including (i) the view of entities including the human and technology, as well as human-technology relations; and (ii) the ways of understanding and influencing people's experiences and relations to technology through design.

on functional, utilitarian, or instrumental values. This is problematic when for example an intent is to design technology for long-term engagement and keeping with usability as the main concern. Fallmann (Fallman, 2011) mentions that the HCI community needs to get at a deeper understanding of human experiences with technology (cf. Verbeek, 2015). Odom et al. (2009) echo that with their work describing attachment as a key factor for future design implementations.

In a human-centered view, humans have goals and intentions, and products help them to realize these in an optimal or even in a fun, embodied, slow, or rich way. In many cases, however, these goals and intentions do not exist independently from the technologies that are used. Furthermore, the human and technology are seen as two separate poles between which there is an interaction[6]. Yet, "interaction might not always be the most helpful concept for understanding the relations between humans and products, or for understanding technological artifacts in general" (Verbeek, 2015, p. 26). There is a strong focus in this framing on functionality. Understanding and approaching the relations (or interactions) between humans and technology in terms of mainly functionality reduces the role of technology or products to instrumentality (cf. Verbeek, 2015). In this, humans' intentions or goals are realized through (rather passive) technologies. However, the relations that come about between humans and technologies could be based on less direct or possibly less conscious ways of engagement that are nonetheless still influenced by technologies.

In conclusion, an exclusive focus on human-centeredness possibly limits both the understanding and influencing of not only people's experiences but more broadly people's relations to technology through design. As a result, human-centeredness in HCI can be perceived as limiting and I explore this proposition in this dissertation. However, HCI works have been trying to break with some of the limits of this perceivably narrow lens expanding aspects of it.

2.1.2. Beginnings of Moving Beyond Human-Centeredness

As focus expanded beyond the office and technologies increasingly became part of people's leisure times, there was a growing need for an alternative value set to guide the design of

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[6] This strongly relates to the subject-object dichotomy common in a humanistic view and also in early works within the philosophy of technology.

technology for everyday life (e.g., Nelson & Stolterman, 2012). Emphasis was put on the need to understand the messiness of everyday life (e.g., emotions, experience, values, new context outside of the office, etc.). In this context, new frameworks for understanding human "experience" (McCarthy & Wright, 2004) and "interaction" (Dourish, 2001) provided an important foundation.

In recent years, however, the focus on interaction and the underlying notion of functionality has been seen as limiting, not fully accounting for unpacking the relations humans have with technology, and also how technology shapes human existence and experiences in the world (Fallman, 2011). As a result, the HCI community has been expanding its focus beyond interaction and functionality and more works are emerging as alternatives to goal-driven, feature-laden, and productivity-oriented ways of understanding digital technologies. Specifically, the third paradigm has grounded some works seeing technology as a matter of experiences which can be seen as a step in this direction. This is a move towards a broader understanding of humans' relations with technology more generally and a start to look at technologies or things beyond solely their functional or utilitarian value to humans. Exemplary works that can be seen as having contributed to this shift are those works that looked at human experiences with technologies considering experiences[7] that are embodied (Dourish, 2001), rich (Overbeeke, Djajadiningrat, Hummels, Wensveen, & Prens, 2003), somaesthetic (Höök, Jonsson, Ståhl, & Mercurio, 2016), spatio-temporal (McCarthy & Wright, 2004), hedonic (Hassenzahl, 2003), reflective (Sengers & Gaver, 2006), fun (Blythe & Hassenzahl, 2003), slow (Hallnäs & Redström, 2001; Odom et al., 2014), and ludic (Gaver et al., 2004).

Collectively, these works already move towards an understanding of the relations between humans and technology that is advancing aspects of human-centeredness in HCI, particularly by moving beyond the notion of functionality or utility as the main value of experiential aspects in human-technology relations. This can be seen as a productive way of advancing human-centered ways of approaching human-technology relations. However, there are more radical ways and possibilities to deepening and broadening the understanding and influencing of human-technology relations, which I aim to explore in my dissertation. Specifically, philosophical perspectives can raise issues about the relations between humans and technology that are still largely overlooked in HCI. A contemporary strand of philosophy of technology called postphenomenology especially offers ways of rethinking human-centeredness

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[7] Also see works such as (Blythe, Overbeeke, Monk, & Wright, 2004; Blythe & Monk, 2018) as related.

in HCI and underlying values. In what follows I will thoroughly explain this philosophical school of thought and its background. Afterwards, I will discuss how philosophy of technology and postphenomenology have already been drawn on in HCI.

2.2. Postphenomenology

Postphenomenology is the concrete and empirical study of the social and cultural roles of technologies in human existence and experience practiced by an expanding group of different scholars. This school of thought was initially developed as a contemporary and empirical strand of philosophy of technology (Ihde, 1990, 1993, 1995; Rosenberger, 2009; Rosenberger & Verbeek, 2015b; Selinger, 2006; Verbeek, 2005, 2011; Verbeek & Kockelkoren, 1998). In postphenomenological studies, philosophy and empiricism blend, marrying approaches of more traditional philosophy of technology including phenomenology and American pragmatism as well as Science and Technology Studies (Rosenberger & Verbeek, 2015a). The postphenomenological approach sees technologies as *transformative mediators* of human-world relations rather than separated functional or instrumental objects or alienating entities (Verbeek, 2005). Technologies mediate humans' experiences and perceptions in and of the 'world'. The 'world' here can be seen as a placeholder for a situational holistic context such as an environment like a home. It could also be an interpretation framework, or one's understanding of the self. Through *technological mediation*, humans and technological artifacts co-shape or *co-constitute* human *subjectivity* and the *objectivity* of their 'world' in any given situation (Rosenberger & Verbeek, 2015a). In postphenomenological studies, concrete case examples of technologies are investigated in terms of the relations humans have with them and the implications technologies have for the relations between humans and their world. Examples of studies are investigations of imaging technologies such as Verbeek's study of obstetric ultrasound (Verbeek, 2008b; Rosenberger & Verbeek, 2015a); where he shows the technology's impact on the relations between parents' and the fetus and on the parents' moral decision-making because the ultrasound *co-constitutes* the fetus as a patient, parents as decision-makers and mothers as environments. Other study examples are the impact of mobile phones while driving (Rosenberger, 2012) and the mediation of implanted technologies (Besmer, 2012). In all of these cases, technologies help to shape both the 'subjects' that use them and the 'world' they live in.

In this dissertation, I chose to explore what the lens of postphenomenology holds for design-oriented HCI. Postphenomenology is a rapidly growing subfield of philosophy of technology and the latest offspring of phenomenology. In the following sections I will describe background works within philosophy of technology and thereafter provide details about postphenomenological concepts and key examples.

2.2.1. Philosophy of Technology

Philosophy of technology, which is believed to have emerged in the later 19th century (cf. Kapp, 1877), as one of the more recent sub-specializations in philosophy, focuses its philosophical analysis on understanding technology and its social effects. As such it covers the critical inquiry of technology as a phenomenon putting technology at the center of its philosophical analysis[8]. Since the emergence of the field, several key philosophers of technology have made important points on human experience and relationships with technology. In the following I will briefly describe some of them to introduce some of the background that has influenced the emergence of postphenomenology.

Martin Heidegger was one of the first philosophers to put technology at the center of his investigations and, moreover, analyze technology in an everyday and practical context. In addition to Edmund Husserl (Heidegger's advisor), Sartre, and Merleau-Ponty, Heidegger counts as one of the classical figures in the movement of phenomenology—the study of 'phenomena' or things as they appear in a person's experience[9]. However, while making points about technology, these figures did so as a means to discussing epistemology or metaphysics. By offering new perspectives of looking at human-technology relations, Heidegger's phenomenological work has influenced many scholars and, consequently, the contemporary perspective of postphenomenology. In Heidegger's work 'Sein und Zeit' (transl. to 'Being and Time') (Heidegger, 1927) he looks at bringing together the human and the world as *Dasein* (transl. to 'being-there'), which implies the human contextually being (involved) in the world. As such, Dasein situates the human in the world and, for Heidegger, the world brings along integrated choices that have been made already. Here, Heideggers notion of *throwness* comes

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[8] See (Ihde, 1993) for a more thorough introduction to the philosophy of technology which includes how philosophers, for instance the early Greek philosophers, thought and wrote about technology before a Philosophy of Technology emerged.

[9] See for example (Woodruff Smith, 2013) for a more thorough review of phenomenology.

into play. He sees being born as being thrown into the world and humans living inauthentic lives per se as there are many choices that have been made for them already. He believes humans should be more conscious about throwness and the inauthentic lives we live.

Looking at Heidegger's understandings of the human-technology relationship, Heidegger sees humans experiencing the world practically through the use of tools, which themselves become somewhat invisible in the experience of use or in his words "ready-at-hand". Using the example of a hammer, Heidegger sees the tool itself belonging to a task and becoming withdrawn as an object but a means of the experience of the task itself. In this view, technology is seen as something separating humans from themselves and the world they live in; it sees technology as alienating. While views like this have produced valuable insights, postphenomenologists think they do not fully account for the roles of technology in the actual experiences of humans.

Several philosophers draw on Heidegger's complex analysis and conceptualizing of being; his work can be seen as pioneering within philosophy of technology. For example, Albert Borgmann deeply considers the consequences and effects of technology in everyday life. In his seminal work (Borgmann, 1984) he discusses his notion of the *device paradigm*, a conceptualization of the often hidden and unseen effects of technology operating in the world. Borgmann argues that we live in such a heavily technologically mediated world that it is actually impossible for humans to see the true effects of how technology shapes their relations with the world. At its core, Borgmann's argument is that technology in its current form makes humans incapable of living 'the good life'[10]. Specifically, in his articulation of the device paradigm, he describes how devices increase the availability of a commodity, but in doing so they also obscure the commodity's broader relation to the world (and often its harmful effects). The dilemma he describes here is that technology increasingly makes goods and services available to us which we have become heavily reliant on, while technology is also producing profound and often destructive effects on people's lives. Borgmann gives examples for that, one being a thermostat. While adjusting a thermostat nearly instantly provides us with heat, this comes at the expense of the various other social and material processes that once came along with producing heat. From this, we can see how technology in Borgmann's view can make something more easily accessible but at the same time obscures other things and practices. More deeply in his view, this 'obscuring effect' distances people from attaining 'the good life'.

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[10] The more philosophical idea of living a meaningful life.

As a response to his own thinking, Borgmann argues that technology ought to be radically reformed to play a more meaningful role in everyday life. Here he has in mind a new focus on *focal things and practices* and technologies. Borgmann describes them as things "of themselves [that] have engaged mind and body and centered our lives. Commanding presence, continuity with the world and centering power are the signs of focal things" (Borgmann, 1984, p. 119). Borgmann uses the hearth as a central example in his analysis to describe a focal thing. Here he reveals how the hearth ties to a broad and holistic set of activities and experiences in everyday life. The chopping of wood, the placing of it in the fireplace, communing with others around the fireplace for warmth and preparing cooking and eating meals here; this helps illustrate the more nuanced and rich characteristics of a 'focal thing and practice'. He concludes by arguing that only by reforming technology to be more attuned to supporting focal things and practices will humans be able to attain the good life in the contemporary, techno-mediated world we live in.

Borgmann makes an important distinction between things and devices. He describes a thing as being tied to a deeper form of engagement than devices can provide. For example, running shoes offer a transparent technology that enables a deeper and richer kind of lived experience, deeply involving the mind and the body. This deeper form of engagement is at the center of Borgmann's idea of what a *focal practice* is. In contrast, a device may offer more of an immediate convenience but in doing so it obscures the richness of lived experience; for example, many rapid exchanges of text messages with a friend versus a long and engaged conversation.

Borgmann, it has been argued, has a fairly negative take on technology and technology developments. Although approaching technology in practice, Borgmann argues that focal things and practices reveal the (negative) patterns of technology. Contemporary philosopher of technology Peter-Paul Verbeek (2005) says he comes "dangerously close" to being dystopian deterministic as there are scenarios in which people can still very much involve themselves with a technology that invites for consumption; using the television as an example.

Langdon Winner, another seminal figure within the philosophy of technology, also has a concerned view of technology and raises issues of how politics are embedded in technology (Winner, 1986). An often-cited example he has analyzed are the numerous low overpasses on the highways to Long Island, New York. Winner describes how these were designed and built deliberately in order to achieve a certain 'social effect'. They were too low for the public transit

buses—used by at the time by poor people and black people—to fit through. On the other hand, people of the upper class who owned cars were able to pass and reach the parks and beaches on Long Island for recreation. Winner hopes for more acceptable conscious technology developments.

Pragmatist works, which have had a major influence on postphenomenology, look at the experience with an object as entailing its making and the experience being embedded in everyday life. This allows for a more neutral or even positive view of technology. Embedded in pragmatism, John Dewey focuses on the experiential nature of art(ifacts) (Dewey, 1934). He argued for instance that the practice of making and crafting an art piece is embedded in the piece itself and therefore becomes part of the overall experience of art. For Dewey, an experience is deeply embedded in everyday life and experience in general is 'the very process of living'. When it comes to art, Dewey explains that the 'artistic' part of art refers to the making and doing of art and the 'aesthetic' part of art refers to the perception, appreciation, and maybe enjoyment of art. Dewey's understanding transferred to technology and humans, could be interpreted in a way that, when a human experiences technology, a certain part of the making and crafting of the technology is part of this experience.

Don Ihde, a more contemporary philosopher of technology, reviews various works within philosophy and philosophy of technology (including all the above mentioned theorists' works) and critically analyzes the impact and effects of technology himself. He pioneers a movement from phenomenological studies of technology, the study of technological experience, towards *post-phenomenology*, which stresses the mediating role of technology (see for example Selinger, 2006) and discards "the classical-phenomenological romanticism regarding technology" (Rosenberger & Verbeek, 2015a, p. 9).

Defining technology, Ihde (1990) notes that technology is culturally deeply embedded, influencing and shaping our world- and self-perception. This pervasiveness of technology with regards to human experiences argues for a non-neutrality of technology affecting human, social, and cultural transformations. "Technologies reveal worlds or world-aspects; they are non-neutral in the ways in which the human-technology uses emerge, and that at several levels (perceptual, socio-political, cultural); and they display—particularly in the ensemble—a variety of implications for human history" (Ihde, 1990, p. 117). Along these lines, Ihde names possible effects and problems of technologies, which are for instance of epistemological nature ("how we can know things" (Ihde, 1990, p. 68)), ethical nature ("what we should or ought to do" (Ihde, 1990, p. 68)),

and socio-political nature ("structures of society" (Ihde, 1990, p. 68)). The impact of technologies can also be problematic, which can be seen at the environmental level or even around topics of social justice. Moreover, issues around the effects of technology can occur ("Is technology alienating? Dehumanizing? Or is it fulfilling? And choice multiplying?" [p.69]). Other problems can occur through the use of technology in science.

Moreover, Ihde (1979, 1990) specifically describes four human-technology relations: embodiment, hermeneutic, alterity, and background relations (those will be described in more detail later). With the description of those human-machine relations, Ihde specifically shows that technology transforms the experience of the world, which speaks to the non-neutrality of technology and, in this sense, technology leads to an experience of a certain world facet or feature, putting something in the foreground and other things in the background (this argument draws on Borgmann's analysis). This non-neutrality of technology is, in fact, one thing upon which philosophers of technology seem to agree.

For Ihde, technology 'must enter' practical context when studying technology, as it can only be defined considering the "relation between the technologies and the humans who use, design, make, or modify the technologies in question" (Ihde, 1990, p. 47).

Ihde also argues that, since rooted in the lifeworld, human-technology relations are always partly ambiguous (Ihde, 1979). This argument strongly relates to articulations about real world complexity and arguments on 'wicked problems' (Rittel & Webber, 1973) within design theory. Reflecting on the future of technology and philosophy of technology, Ihde (1990) explicitly argues for the potential of an integration of philosophical analysis as an element into the development processes of technologies, directly speaking to an integration of arguments from the philosophy of technology into interaction design works. Additionally, speaking directly about designers and technologies in their practical context, (Ihde, 2008b) more recently introduced his idea of the designer fallacy, which articulates that designers may design an artifact with an intent of potential, purpose and use; however, the artifact will always be interpreted and appropriated in a practical context in ways that cannot be foreseen and controlled. Ihde says that designers "must take into account unintended uses and consequences, the constraints and potentials of materiality, and cultural context, which often are complex and multistable" (Ihde, 2008b, p. 51). Ihde sees his examination of the designer fallacy as "an inter-relational interpretation of a human technology-uses model in which the human, material, and practices all undergo dynamic changes" (Ihde, 2008b, p. 59) presenting a new

perspective and implications for designers and design education. With the work of Don Ihde, the contemporary school of thought '*postphenomenology'* began to develop and is now used by many scholars.

The work of phenomenologist Ihde can be seen as a main initiating and influencing body of work within the development of postphenomenology. Ihde's analysis of human-technology relations began shifting parts of the phenomenological tradition towards "understanding the *relations* between human beings and their world" as human-technology-world relations with technology given a central position seen as rather *mediating* (and not alienating) human-world relations. Through this postphenomenology strongly diverges from aspects of 'classical' phenomenological views. The 'post' in postphenomenology can be read as the field distancing itself from "the romanticism of classical phenomenology" (Rosenberger and Verbeek, 2015, p.11) and aspects like the subject-object dichotomy[11].

More recently, contemporary philosopher of technology and postphenomenologist Peter-Paul Verbeek has contributed largely to the postphenomenological strand and body of work within the philosophy of technology (e.g., Verbeek 2005, Verbeek 2008a, Verbeek 2008b, Verbeek 2011). He also offers a rare perspective that directly incorporates an understanding of design within a synthesized review and rethinking of previously described dominant perspectives in philosophy of technology in the 20th century. The philosophical framework Verbeek develops is particularly compelling to design research as it is situated within key environmental problems bound to industrial design and explores the question of why human-technology relations are often so fleeting. His work shows how a better understanding of the interrelations of humans, technology and the world can offer a productive framing for investigating the design of more sustainable interactions—and ultimately relations—with technology. At the center of Verbeek's critical analysis lies '*technological mediation'* – technological artifacts mediating the being of humans in the world and thereby shaping and affecting humans and their being in the world – and he incorporates looking at contemporary technologies (including brain implants, smart and ambient technologies) (Verbeek, 2005). *Mediation theory* – how he has most recently framed his studies on technological mediation – views technologies as mediators. "The central idea in mediation theory is that technologies do not simply create connections between users and their environment, but that they actively help

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[11] More on how postphenomenology diverges from earlier philosophical views is explained for example in (Verbeek 2005). This development is also situated within what he calls a necessary "thingly turn" (e.g., p.3) or a 'turn towards things.'

to constitute them" (Verbeek, 2013, p.84). "When used, technologies establish relations between human beings and their environment. […] Technologies, in other words, help to shape human experiences and practices" (Verbeek, 2013, p.84; also see Verbeek 2005). This has also been referred to as *co-shaping*.

Verbeek, directly relating his reflective analysis to the producers of technology, industrial designers, states, "designing technology is designing humanity" (p.30) or "human existence" (p.29). As a result of this he incorporates the ethical aspect of human-technology relations in his analysis, specifically the moral aspects and implications of technological artifacts and the resulting implications for design. He says that designers through their practice "materialize morality" (Verbeek, 2011). This intersection of philosophy of technology and design makes Verbeek's work seem more approachable for (interaction) design research or design-oriented HCI research. Verbeek essentially argues, that we ought to take more seriously the role of artifacts and their material qualities in the investigation of technological mediation. For example, he proposes the concepts of *transparency* and *engagement* (Verbeek, 2005) as concrete ways of moving beyond focusing solely on functional or symbolic values toward incorporating a much more rigorous understanding of material aesthetics. Verbeek's notion of *engaging artifacts* offers a new way of thinking about artifacts. Such products, that require deep human involvement with the artifact and its materiality speaks directly to contemporary alternative approaches in interaction design research, essentially arguing for the interaction between technologies and humans creating meaning. Nonetheless, little work exists that has effectively drawn upon and translated his high level philosophical ideas into a form and language that can be more fluidly drawn on and applied within design-oriented HCI.

Peter-Paul Verbeek's work and insight is central to this dissertation. He has been serving as a supervisor on the doctoral advisory committee and works closely with the author.

2.2.2. Postphenomenological Commitments and Key Examples

At the core of postphenomenology, which is inspired by the philosophy of technology, is "the philosophical question of how the role of technology in human existence and experience can be understood" (Rosenberger & Verbeek, 2015a, p. 11). The aim is to answer this question in terms of the physical relationship humans have with technology, and the ways technology affects, shapes, and transforms humans, their experiences, and relationship with the world. In postphenomenological analyses an actual technology is being investigated in a given contextual

setting. This empirical character differentiates the kind of philosophical investigation that takes place in postphenomenology from other and previous philosophical approaches inquiring into technology. The methods used are drawn from both the philosophy of technology and Science and Technology Studies (STS) by "bringing together the empirical orientation of STS on concrete case-studies with the conceptual and also normative orientation that are characteristic for philosophy of technology" (Rosenberger & Verbeek, 2015a, p. 10).

Features and characteristics across postphenomenological research endeavors can be described as the following three points:

1. *Empirical work as the basis of the inquiry*
   Postphenomenological studies "always include empirical work as a basis for philosophical reflection" (Rosenberger & Verbeek, 2015a, p. 31).

2. *Structures of human-technology-world relations as a starting point*
   Postphenomenological studies aim at "understanding the roles that technologies play in the relations between humans and world" (Rosenberger & Verbeek, 2015a, p. 31).

3. *Analysis of how technology co-constitutes objectivity and subjectivity of any given situation (technological mediation)*
   Postphenomenological studies "typically investigate how, in the relations that arise around a technology, a specific 'world' is constituted, as well as a specific 'subject'" (Rosenberger & Verbeek, 2015a, p. 31).

Lastly, postphenomenological studies "on the basis of these three elements […] typically make a conceptual analysis of the implications of technologies" (Rosenberger & Verbeek, 2015a, p. 31), which is based on the features of their analysis and a philosophical outcome of the work, so to speak.

Empirical work as the basis of the inquiry

Central to postphenomenological studies is that empirical work is the basis for the philosophical reflection. Rather than applying philosophical work to technology in a broader sense, postphenomenological insights are derived from actual experiences with certain technologies. As Rosenberger and Verbeek describe, the purpose of the empirical work is "to investigate the character of the various dimensions of the relations between humans and these technologies,

and their impact on human practices and experiences" (Rosenberger & Verbeek, 2015a, p. 31). Empirical work in postphenomenological investigations can include self-conducted studies, first-person experiences, and studies conducted by others. Frequently the types of investigations are combined.

First Person Experiences

Investigating the implications of a technology through a first-person experiential account is most common in postphenomenology. Ihde has reported on his experience with hearing aids (Ihde, 2007) and a heart stent (Ihde, 2008a); Verbeek on his and his wife's experience with obstetric ultrasound (Verbeek, 2008b, 2011).

Self-conducted studies

An example of a postphenomenological investigation based on self-conducted research data is Rosenberger's investigations of the politics of park benches and other public-space objects (Rosenberger, 2014, 2017). Over several years, he has collected several hundreds of pictures of public-space objects from all over the world (Rosenberger, 2018), which he argues are being designed against homeless populations.

Empirical Work by Others

Many postphenomenological investigations are based on empirical work by others or at least involve such data alongside self-gathered data. In his investigation, Rosenberger (2012) studies data gathered by cognitive scientists to make an argument around the mediation of cell phones while driving, including when on speaker phone, and against the use of cell phones in any way while driving. Although using empirical work by others, Rosenberger additionally brought in his own first-person experiences to the study. Wellner (2016) also conducts a postphenomenological inquiry into cell phones, however, on a broader level looking back at the history of cell phones and the role they play in contemporary everyday life.

Structures of Human-Technology Relations as Starting Points

Postphenomenological studies begin their analyses with particular technological encounters and the structure of human-technology relations at play. They then usually move into an analysis of technological mediations in human-technology-world relations. Ihde (1990) argues that humans encounter technologies through four bodily-perceptual relationships: as an *embodiment*, as an

alterity, through a *hermeneutic*, or a *background* relation. In the next sub-sections, I will describe these four relationships, which are neither exhaustive nor mutually exclusive.

The Embodiment Relationship

A technology is being *embodied* when a part or an aspect of the world is experienced or perceived *through* the technology. Classic examples that postphenomenological philosophers have examined are glasses or wearable technologies such as hearing aids (Ihde, 2007). The mobile phone, for instance, enables a person to experience a conversation through a phone; in this case, the phone is embodied and almost moves into the background (Rosenberger, 2012). In embodiment relations, technologies, or aspects of them, fade into the background to a certain degree. Ihde describes this as *transparency* (Ihde, 1990). For example, if someone has grown very accustomed to their glasses, they may be barely noticed (Rosenberger & Verbeek, 2015a).

The Hermeneutic Relationship

When a technology is hermeneutically encountered it is '*read'* and reveals a certain aspect of the world to humans who *interpret* it. For example, a thermometer lets humans hermeneutically know that it is cold or hot. Through such technological encounters, humans receive access to an aspect of the world by being provided with a representation of it, which then requires interpretation to be made sense of.

The Alterity Relationship

When a technology is *being interacted with* and becomes '*quasi-other*' or *'quasi-autonomous',* postphenomenologists characterize this as an alterity relation. In this case, humans interact with a technology whereas the world moves in the background. Examples that have been used in postphenomenology include GPS navigation systems and ATM machines.

The Background Relationship

A background relation is at play when a technology is operating but not calling for focal attention; nevertheless, it is still shaping people and their surroundings or context (Ihde, 1990). Ihde calls this *contextual* state an '*absent presence'* when a technology is not directly used but still being experienced, becoming "a kind of near-technological environment" (Ihde, 1990, p. 108). We are typically not aware of such technologies when they function or are in operation (e.g., much like today's smart technologies, IoT devices, or cloud technologies). The technological mediation of background technologies is often more through the "indirect effects

upon the way a world is experienced" (Ihde, 1990, p. 112). Key examples in this context that postphenomenologists draw on are semi-automatic machines, such as a fridge or a heating system.

Collectively, these bodily perceptual relationships that come about between humans and technology show how technologies in such structural relationships can go from being very close to the body (i.e., embodied), towards moving further (i.e., hermeneutic), and further (i.e., alterity), away from the body towards being unnoticed and moving into the background.

Cyborg Relations

Verbeek extended these relationship structures with three more *cyborg* relationships (Verbeek, 2008a) to cover additional contemporary human-technology structures. First, in the *fusion relationship*, a technology merges with the human in a way that is more intimate than an embodiment relation. Examples of this relation are implanted technologies like brain implants. Second, in an *immersion relationship*, a technology merges with the environment in a way that it is in the background and part of an interactive context. Examples of this relation include ambient technologies that detect human presence or smart toilets that generate health reports. Third, *augmentation relationship* is an embodiment relation and a hermeneutic relation combined, which is the case with, for example, Google Glass.

Multistability

Multistability is a concept used in postphenomenology to describe the fact that technology that can be used in multiple ways and that we can have multiple relationships with the same technology (Ihde, 2009; Rosenberger & Verbeek, 2015a). A typewriter for example was originally designed for the use of visually impaired people, yet was adopted into many other uses. Wellner (2016) talks about all the different functions that a smart phone has including a clock, maps, apps, email functionality, text messaging, in addition to the primary use or stability of talking on the phone. Rosenberger (Rosenberger, 2014, 2017) speaks about multiple stabilities of objects in public spaces being used in different ways or having different stabilities that can be described.

Postphenomenological Field Theory

Specifically, when introducing embodiment relations, Ihde speaks of users' transformed experience of the world *through* a technology, and in this, an *amplification* and *reduction* at play.

The notion of *transparency* (Ihde, 1990) was used to describe "the degree to which an embodied technology recedes into the background of a user's awareness as it is used" (Rosenberger & Verbeek, 2015a, p. 25). Beside a blind man's cane, Ihde mentions other examples of technologies that are often if not primarily used in embodiment relations, such as glasses, telescopes, hearing aids, and a dentist's probes. These items are artifacts that *'withdraw'* when used, and serve as semitransparent means through which one's environment is perceived.

Particularly to further such characterizations in and of embodiment relations, Rosenberger (2012) expanded Ihde's notion of transparency and developed a postphenomenological *field theory* that attends in a more detailed way how technological mediation composes and shapes a user's overall field of awareness. In this theory, three variables present in (technological or non-human) mediation are described: *transparency, field composition*, and *sedimentation*. Transparency is defined as "a variable, that is, as a feature of technological mediation which may be present to a greater or lesser degree depending on the circumstances of the individual relation" (Rosenberger, 2012, p. 84). In addition to transparency, field composition refers to ways an overall field of awareness is 'composed' with the aim to "articulate the ways that technological mediation reorganizes a user's field of awareness" (Rosenberger & Verbeek, 2015a, p. 25). Lastly, sedimentation is described as "the force of habit associated with a given human-technology relation" (Rosenberger & Verbeek, 2015a, p. 25).

Rosenberger's field theory can also be situated within mediations, particularly within the hermeneutic domain of mediations and the in-depth engagement with the mediated perception of humans, as will be discussed in the next section.

Technological Mediation: Technology Co-Constitutes Objectivity and Subjectivity

In addition to the structure of relations at play between humans and technologies, postphenomenology looks at the accruing implications or *mediations*. Verbeek (2005) describes technological mediation happening on an *existential* level, meaning "[h]ow humans appear in their world" or their actions and practices, and on a *hermeneutic* or experiential level, meaning "[h]ow reality [or the world] appears to humans" or their perception and experience (Verbeek, 2005, p. 196). In this, technologies work to *amplify* and *reduce* human perception and experience, and *invite* and *inhibit* human action and practices in any given situation. In other words, this part of an investigation focuses on how, in the relations that arise around a

technology, a specific "world" or objectivity and a specific "human" or subjectivity is constituted; and what the implications of this are. These details of technological mediation are illustrated in Figure 1.
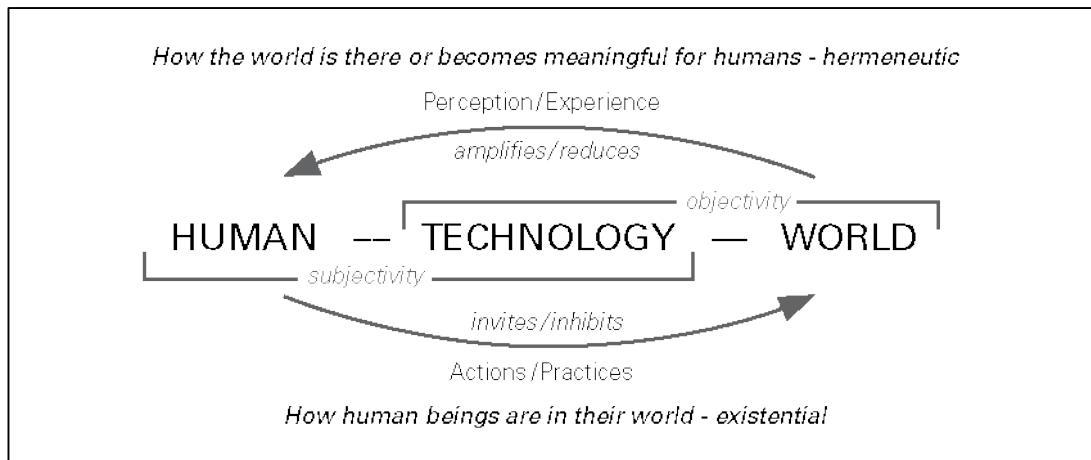
Figure 1 Illustration of technological mediation (based on Verbeek's descriptions).

As an example, in the previously mentioned study of obstetric ultrasound (Verbeek, 2008b; Rosenberger & Verbeek, 2015a), Verbeek shows how the mediating effect of this technology can impact parents' access to the fetus and, in doing so, shape their moral decision-making. His analysis also reveals how this technology *co-constitutes* the fetus as a patient, parents as decision-makers (subjectivity) and mothers as environments (objectivity). The questions guiding my analysis of the research products for this theme are: *What are mediations of the technology in people's lives? What kind of 'world' (objectivity) and what kind of 'human' (subjectivity) is co-constituted by the technology?*[12]

In summary, the postphenomenological strand of the philosophy of technology potentially brings to HCI ways to rethink the relations between humans and things and subsequently the way humans and technology can be understood. Notably, postphenomenology presents the idea of understanding technologies as *transformative mediators* of human-world relations rather than separated functional, instrumental objects or

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[12] Throughout this dissertation I work through analyzing mediations for instance of guide dogs. In this process, I engage with mediation and underlying concepts on a deeper level. For this see section 3.3.2 as well as Appendix A.4 and A.5.

alienating entities (Verbeek, 2005). Technologies mediate humans' experiences and perceptions in and of the world as it is to the human. Through *technological mediation*, humans and technology mutually shape each other in the relations that come about between them. In that respect, agency is distributed across the human and technology and intentionality is viewed as inherently mediated. The human is no longer understood as an autonomous agent. In postphenomenological studies, concrete case examples of technologies are investigated in terms of the relations humans have with them and several potential sets of bodily-perceptual human-technology relations are considered. For example, technology could be encountered as an *embodiment*, as an *alterity*, through a *hermeneutic*, or a *background* relation.

Given these points, postphenomenology seems to present a diverse and holistic view that considers the human and the many different kinds of relations that can emerge with technology. This philosophical lens could potentially offer conceptualizations of the relations between humans and technologies that can deepen an understanding of what 'interaction' means in the context of HCI (cf. Verbeek, 2015).

2.2.3. Philosophy of Technology and Postphenomenology in HCI

The philosophy of technology puts technology at the center of its philosophical analysis and critical inquiry of technology as a phenomenon. The field has been exploring and analyzing how technology affects and shapes humans for decades. Key philosophers including Heidegger, Borgman, Ihde, and Verbeek describe relevant points on technology and its effects on humans and the world. These philosophers' works can be particularly useful as a lens for interaction design research efforts to help explore human-technology relations, because they offer descriptive and analytical articulation to understand how technology mediates human experience with the world.

Alongside the movement between paradigms in HCI, the philosophy of technology has found its way into HCI works. A strand of early research has looked at the works of philosophers of technology, specifically the analytical works of Martin Heidegger, who offered a very critical view of technology. For example, early on Winograd and Flores (1987) pushed for a better understanding of 'what it means to be human' and for considering the human experience of technology and how technology shapes human lives. Dourish (2001) paid specific attention to the notion of embodied interactions with technology. McCarthy & Wright (2004) drew on

pragmatist philosopher John Dewey to engage with experiential aspects of technology. However, still at an early stage at that time, the philosophy of technology had not been able to react to the integration of computational technologies into our world and everyday lives.

More recently, works in HCI have appeared in which more recent works of the philosophy of technology have been discussed or drawn on. These works are seminal and show the potential of using the analytical works from the philosophy of technology in interaction design research. In several publications, Fallman (2007, 2010, 2011) specifically argues that HCI needs a philosophy of technology. He sees value in integrating a new philosophical lens into discussions surrounding the nature of the technologies that HCI research develops and their human, social, cultural, ethical, and political implications.

Several works have drawn on the works of contemporary philosophers Borgmann, and Ihde, as well as Peter-Paul Verbeek who directly relates the philosophy of technology and design showing that the philosophy of technology can be useful in HCI to better understand the human-technology relationship and to help develop and advance their work on nascent topics such as factoring in the attachment of the human-technology relationship (Odom et al., 2009) or the intentional negation of technology in design (Pierce, 2012). The move to a more contemporary philosophical orientation of postphenomenology promises to support the development of theoretical framings for design that account for the complexity of human-technology-world relations to create novel and concrete interventions. For example, Fallmann (2011), in discussing Borgmann's notion of the device paradigm (Borgmann, 1984) and the idea of the non-neutrality of technology-mediated experience (Ihde, 1979; Winner, 1986)—a key point in postphenomenology, raises issues within guiding visions and values in HCI. Odom et al. (2009), grounded in concepts of the philosophy of technology, describe attachment as a key factor in human-technology relations for future design implementations. Informed by phenomenological accounts and a defined set of human-technology relations (Ihde, 1990), Pierce and Paulos (2011, 2013) analytically uncover and describe new ways of relating to and experiencing electricity and also explore electric materiality. Furthermore, concepts like personal informatics (Ohlin & Olsson, 2015) have been analytically re-examined through the utilization of the postphenomenological framework to discuss the changing agency of users. Wiltse and Stolterman (2010) use the framework to analyze the interaction architectures of instant messaging and file sharing to reveal how these interactive spaces mediate human activity. Other recent works have drawn on postphenomenology to investigate the ontological gap

between humans and things in thing-oriented inquiries (Wakkary et al., 2017), social practices (Wakkary, Hauser, & Oogjes, 2018), and the representation of things (Oogjes & Wakkary, 2017).

Collectively, these emerging works illustrate that the philosophy of technology is becoming utilized as a productive theoretical perspective in HCI and interaction design research. More recently, postphenomenology is gaining interest in HCI. Yet, despite these developments, there is a lack of work that draws on postphenomenology in a reflective way to change ways of understanding and influencing human-technology relations. Within the philosophy of technology, nascent efforts exist to make postphenomenological ideas, concepts, features, characteristics, and methodology more accessible (Rosenberger & Verbeek, 2015a). There is now an opportunity to bring these new developments back to HCI, which is a main activity or goal of this dissertation building on a reflexive engagement with a postphenomenological framing in an of design-oriented HCI research inquiries.

2.3. Concluding Remarks

This chapter discussed works that are related to and ground this dissertation. It detailed how HCI as a field has been evolving with mainly a human-centered perspective on understanding the relations between humans and technologies. However, as illustrated, an exclusive focus on human-centeredness limits both the understanding and influencing of not only people's experiences but more broadly people's relations to technology through design. A way of addressing those limits is by paying close attention to human-technology relations. The philosophy of technology offers such a perspective attending to the nuances of human-technology relations. Specifically postphenomenology, a rapidly growing subfield of philosophy of technology, was discussed in detail including key commitments and concepts that will be utilized in the following chapters. This contemporary strand within the philosophy of technology particularly pays attention to a holistic and nuanced view of human-technology relations in a way that seems most productive for the endeavor of this work (to complement human-centered perspectives in design-oriented HCI). Postphenomenology, through its empirical character, seems to be approachable from a more practical HCI perspective than for example previous phenomenological works from the philosophy of technology. It is a contemporary offspring of phenomenology and offers recently developed guidelines to adopt. Moreover, parts of the

philosophical framework have already been utilized in HCI yet it was shown that there is a need for more work to directly draw on it and work with it in a reflexive way and generally to develop a utilization in HCI further. For example, the overcoming of the subject-object dichotomy is important to be looked at from an HCI point of view.

Chapter 3.
Methodology

This doctoral dissertation presents a reflexive account of a design researcher integrating postphenomenology as an analytical lens to explore what a postphenomenology-informed approach holds to complement human-centeredness in the context of design-oriented HCI. It is motivated by the possibility that human-centeredness in HCI may obscure aspects of the understanding of humans, technology, and the relations that come about between them.

This chapter details the methodological and epistemological commitments of this research, which is of qualitative nature; it is creative, exploratory, and relying on a 'researcher-designed framework' (Creswell, 2009, p. 19) that is unique to this dissertation.

There are two lines of approaching the main goal of this doctoral work; first, through the use of two specifically chosen cases of my own research practice which challenge aspects of commonly human-centered ways of approaching. The first case is the study of guide dog teams, is a design ethnography of a human-guide dog hybrid implying an expanded focus centered on a human–non-human team rather than solely a human. The second case is the studying of the table-non-table, a generative exploration moving beyond utilitarian ideas of functionality. In other words, it is a research artifact that I use to investigate the boundaries of utilitarian aspects and common assumptions around technology use and design. The second way of approaching the complementing of human-centeredness in this dissertation is through utilizing postphenomenology as an analytical lens. Postphenomenology is a philosophical framework that puts technology at the center of its inquiry and views humans as entities with relations. In the first research case, postphenomenology is used retrospectively. In the second case, it is used in a fashion that occurs mid-way in the research process.

Moreover, in an additional step, some of the research findings will be extended and generalized or vertically grounded (Höök & Löwgren, 2012; Löwgren, 2013) through the development of an annotated portfolio of prior generative research inquiries (similar to the table-non-table) with a postphenomenological framing.

In what follows, methodological commitments around these cases will be illustrated and grounding works discussed.

3.1. Design Research as Reflective Practice

In his book *The Reflective Practitioner,* Donald Schön (1983) (widely cited in HCI and design research) coins the notion of *design* being a *reflective practice* in which designers reflect on their undertaken actions in order to find solutions for problems and to improve the design methodology. He sees reflective practices as consisting of artistic, "spontaneous, intuitive" processes which practitioners like designers go through in order to find solutions for situations containing aspects of "complexity, uncertainty, instability, uniqueness and value conflict" (p.18).

As part of this work on describing reflective practices, Schön also coined the terms of *reflection-in-action* and *reflection-on-action*. Reflection-in-action refers to practitioners' knowing and doing within the processes of their practice. Moving along in the process, a practitioner thinks about what she is doing as she does it, making use of practical knowledge that underpins the practice (cf. Rolfe, Freshwater, & Jasper, 2001 who speak about nursing as a reflective practice). Schön notes: "When someone reflects-in-action, he becomes a researcher in the practice context. He is not dependent on the categories or established theory and technique, but constructs a new theory of the unique case" (Schön, 1983, p. 68).

Alternatively, reflection-on-action involves reflecting or contemplating on practice efforts retrospectively taking into account new information or theoretical perspectives. In this, the reflective practitioner might think about how a situation could have been handled differently in order to improve future practice efforts. As Schön explains, practitioners "reflect on action, thinking back on what [they] have done in order to discover how [their] knowing-in-action may have contributed to an unexpected outcome" (Schön, 1983, p. 26).

The notion of design being a reflective practice also applies well to design research. As a researcher, I can engage in both reflection-in-action and reflection-on-action within my practice of design research. I illustrate this throughout my dissertation.

In my first research case I will engage more in a reflection-on-action approach through the retrospective postphenomenological analysis of guide dog teams; and in my second research case more so in a reflection-in-action approach through a midway integration of

postphenomenology as a theoretical lens in my design research practice. By applying both ways of reflection, I am taking a reflexive position. Sandeldowski and Barroso (2002) describe reflexivity as a 'hallmark' of qualitative research and as entailing "the ability and willingness of researchers to acknowledge and take account of the many ways they themselves influence research findings and thus what comes to be accepted as knowledge. Reflexivity implies the ability to reflect inward toward oneself as an inquirer; outward to the cultural, historical, linguistic, political, and other forces that shape everything about inquiry; and, in between researcher and participant to the social interaction they share" (Sandelowski & Barroso, 2002, p. 222). Miles & Huberman echo this by saying that qualitative research "requires […] connecting with important audiences" (Miles & Huberman, 1994, p. 280)—importantly, with the first audience being *oneself*.

3.1.1. My First-Person Position in this Research

The qualitative approach of this dissertation's research is building on, and only possible because of, my first-person perspective and experiences as a *reflective design research practitioner*. I was involved in conducting the research studies before and after using a postphenomenological lens allowing me to bring in the reflexivity circuits of a design researcher. In this way, I embody the epistemological commitments that I then reflexively iterate on using an added analytical lens. Thus, I am taking full advantage of being the design researcher who conducted the research in order to (self-)reflect on the practice efforts and additionally build on them and engage in presenting them again. In this, questions are developed that I am asking myself and with the tacit knowledge I have am able to answer or address these through nuanced, reflexive, and personal experience.

First-person perspectives, which has its epistemological roots in sociology and anthropology, has been increasing in design-oriented HCI research in recent years (e.g., Boehner, Sengers, & Warner, 2008; Höök et al., 2018; Ljungblad, 2009), particularly concurrent with breaking from cognitive psychology, objective accounts, rigid and replicable studies and context (first and second wave HCI) and the gaining interest in experiences (third wave HCI) (e.g., McCarthy & Wright, 2004) especially beyond usability, efficiency, and functionality (e.g., Blythe et al., 2004; Blythe & Monk, 2018). As a result, autoethnographical accounts of experiences as part of HCI research have been gaining purchase across a number of domains including bodily experiences of horse-back riding (Höök, 2010), experiences of skateboarding

(Pijnappel & Mueller, 2013), self-tracking (Williams, 2015), practicing DIY biology (Fernando, Pandelakis, & Kuznetsov, 2016), and others (e.g., Cain & Trauth, 2017; Cecchinato, Cox, & Bird, 2017; Chamberlain, Bødker, & Papangelis, 2017). Some of these works fall within the domain of soma-based experiences and fostering the emerging area of soma-based designs (Höök et al., 2018, 2016).

Autobiographical design is highly related to this. It similarly relies on first-hand experiences but involves as part of the experience the designing and living with a system and reporting on that (e.g., Desjardins & Wakkary, 2016; Gaver, 2009; Neustaedter, Judge, & Sengers, 2015; Sengers, Boehner, Warner, & Jenkins, 2005; Sundström, Jaensson, Höök, & Pommeranz, 2009).

Collectively, first-person research, autoethnographical, and autobiographical design can be seen as productive research methods (cf. Neustaedter & Sengers, 2012).

3.1.2. Using Theory in Design Research Practice

In recent years in HCI, there have been important discussions on the role of theory in design research (cf. Redström, 2017). Critical questions have been asked such as: What constitutes theory in design? How is it enacted? How is it produced? How does theoretical knowledge through and in design practice define and shape the field of design research? These large epistemological questions fuel necessary internal reflections within the community on what makes design a research field. These questions make explicit that the *practice* of design research is integral to the ability of the field of design to create *research knowledge*. This opens up a view of design research from the perspective of practice that provides the opportunity to give accounts of the messy interplay between theoretical groundings, the making of things, and design researchers in the service of creating new knowledge through research. Gaver (2012) suggests design research has utilized and produced a wealth of diverse theoretical knowledge from new design theories (e.g., Djajadiningrat, Matthews, & Stienstra, 2007) to drawing on theories external to design (e.g., product attachment theory (Zimmerman, 2009)), to producing manifestos (e.g., ludic design (Gaver et al., 2013, 2004)), to frameworks (e.g., Frogger framework (Wensveen, Djajadiningrat, & Overbeeke, 2004)). However, more than not, these theories are presented as complete and well-defined entities far removed from the vagaries of the design practices bound to

their making, or imported theories that emerge unperturbed and unaffected from encounters with design.

I believe it is important to look under the hood of well communicated theories in design-oriented HCI research and epistemological conceptualizations to attend to the "doings and sayings" of the practices of such design research, to borrow a phrase from philosopher Theodore Schatzki (2002). From within the practices of research and making, we can better understand the relations of theory to things, and how this interweaving of theory determines, reveals, and creates new knowledge in and around the things of design research.

Concept-driven interaction research (Stolterman & Wiberg, 2010), strong concepts (Höök & Löwgren, 2012), and annotated portfolios (Bowers, 2012) are advanced articulations of theorizing in interaction design research. They offer a shared understanding of knowledge production in design research, which I leverage and aim to directly build on. Specifically, these approaches articulate a type of design knowledge that lies between theories and design instances. Höök and Löwgren (2012) characterize this as *intermediate-level of knowledge*. Stolterman and Wiberg (2010) see their work as addressing a gap in design theory between practical guidelines and grander theories imported from other disciplines, namely the social and behavioral sciences, neither of which effectively inform design practices. Bowers (2012) and Löwgren (2013) for example see annotated portfolios offering design knowledge that is situated within an intermediate-level knowledge in design research. I see my work, especially my work in Chapter 5 and Chapter 7 as situated within intermediate-level knowledge. I also specifically pick up on Höök and Löwgren's vertical grounding in Chapter 7 (Höök & Löwgren, 2012; Löwgren, 2013) where I develop an annotated portfolio to extend and generalize research findings and also to provide a scaffolding for future research.

As suggested by a number of scholars (e.g., Zimmerman, Forlizzi, & Evenson, 2007), reflexive practice can improve design and research methodology. Schön (1983) suggests that there are significant contributions that can come from the reflexive practice of design which can translate to design research. If we as HCI design researchers attend to the practice of design research, and particularly the relationship between theory (in this dissertation's case postphenomenology) and the ways we study humans and technology (case I) or conduct artifact inquiries (case II), it affords a new and different perspective on the critical elements of design research. This underscores the need to provide accounts of practice to reveal that design research is built on diverse approaches and particularities of embodied, situated inquiries and

creative actions that inherently resist a standardization of research practice, not unlike the practices of design.

3.1.3. Using Postphenomenology as a Theoretical Lens

In qualitative research, theoretical frameworks are used to frame research endeavours. Creswell describes the use of a "theoretical lens or perspective in qualitative research" as providing "an overall orienting lens that is used to study questions" and "becom[ing] an advocacy perspective that shapes the types of questions asked, informs how data are collected and analyzed, and provides a call for action or change" (Creswell, 2009, p. 62). Creswell further describes the emergence of this kind of research: "Qualitative research of the 1980s underwent a transformation to broaden its scope of inquiry to include these theoretical lenses. They guide the researchers as to what issues are important to examine and [what] need[s] to be studied. They also indicate how the researcher positions himself or herself in the qualitative study" (Creswell, 2009, p. 62).

In this dissertation, I utilize postphenomenology as a theoretical lens in my research cases and to address my research problem and question. For this, I have elaborately studied postphenomenology over the course of two years and more broadly the philosophy of technology and importantly also been consulting with philosophers conducting postphenomenological studies.

As mentioned by Rosenberger and Verbeek (2015), "postphenomenology does not follow a strict postphenomenological methodology. […] Rather, it embodies a specific way of investigating technologies, an approach to technology that combines an empirical openness for the details of human-technology relations with phenomenological conceptualization" (Rosenberger & Verbeek, 2015, p. 31). Hence, I apply postphenomenology as an analytic lens in my design research practice to inform my ways of *thinking* and *doing*. I do this by utilizing postphenomenological concepts and characteristics (as explained in section 0) into my understanding and studying of the entities I am encountering in my studies (i) that is the human, the technology, and contextual settings, which avoids a focus solely centered on the human. I also apply them in my understanding and study of the emerging relations (ii), which looks at relations beyond solely interaction.

Although postphenomenological ways of studying are empirical they still rely on philosophical concepts that at times can seem abstract and not easily usable to a design researcher. To overcome this challenge, I followed an iterative process going back and forth between broader more abstract thinking about what I was doing and the more in-depth honed-in way of actually doing research moving along. During this process, I also consulted with experts in the philosophy of technology and postphenomenology experts Peter-Paul Verbeek and Robert Rosenberger.

3.2. Choosing the Research Cases

The two research cases were chosen based on a variety of factors. First, taken together, they both represent different but primary forms of design-oriented HCI research. Design-oriented ethnography is one of the primary forms of design-oriented research in HCI. It involves studying people and the context they inhabit, typically to develop new ways of understanding emerging research topics and domains within HCI and to inform new design interventions. The guide dog team case (case I) is exemplary of this type of design-oriented HCI research. The careful crafting of design artifacts and the careful study of them in people's real-life context is another primary form of design-oriented research in HCI. The table-non-table case is exemplary of this type of design-oriented HCI research (i.e., Research through Design).

Second, I have nuanced and in-depth knowledge and insights to both research cases from a first-person perspective and can speak to the intricacies of them. I have conducted all studies and observations as well as data analyses in leading roles in both studies.

Third, both cases challenge aspects of human-centered ways of approaching within an HCI study. As previously mentioned, one way of approaching the attempt of this work to complement human-centeredness is by using two of my own research practice cases that specifically challenge some aspect of common human-centered ways of approaching humans and technology. Although initially the study of guide dog teams was not seen this way, in this doctoral work, it is viewed as a research case that presents an expanded focus centered on a human-non-human team rather than solely a human (i.e., guide dog teams rather than guide dog users). In the original study, I attended to the strong bond between handlers and their dogs and turned towards studying guide dog teams. Thereby the epistemological commitment towards human-centeredness was challenged. This hybridity of the human handler and the dog

can be seen as similar to the postphenomenological notion of how human subjectivity is co-shaped by technology or technological mediation. This I realized after my commitment to and study of postphenomenology and it led me to take a closer look at the possibility to reflect on the study again. Additionally, looking into related prior works, I saw a connection to earlier philosophical works that had already looked into the relationship between visually impaired people and the long cane (cf. Merleau-Ponty, 1945).

On the other hand, the table-non-table is in and of itself a generative exploration moving beyond utilitarian ideas of functionality, because it is a research artifact that is designed to be functional yet not in the service of human use. This way the table-non-table investigates into boundaries of utilitarian aspects and common (human-centered) assumptions around technology use and design.

Fourth, the two cases allow me to demonstrate how the use of a postphenomenological lens can productively shape, extend, and enhance forms of HCI research for the HCI community.

Lastly, both cases show ways of advancing not only HCI ways of thinking and doing but also postphenomenology's. From a postphenomenological point of view, the retrospective analysis of guide dog teams using the theoretical framework as a lens, presents a cutting-edge case[13]. By looking at an animal or animate 'object', it expands upon previous postphenomenological studies which are of inanimate objects. Yet, is still connected and building upon previous cases such as studies of the long cane discussed by Merleau-Ponty (Merleau-Ponty, 1945) and hearing aid users discussed by Don Ihde (Ihde, 2007). The postphenomenological analysis of the table-non-table, a speculative research artifact, also pushes the boundaries for the field which usually does not study unfamiliar technologies that do not have social norms established around them, or are designed to function but not in the service of humans.

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[13] Please, refer to section 7.3 for a more thorough description of how this dissertation can offer insights to the field of postphenomenology.

3.3. Design Research Case 1: Studying Guide Dog Teams

In this subsection, I describe the methodological and epistemological commitments of the first research case, the studying of guide dog teams. For this, I first describe my role in the original study and briefly speak to the methodological approach. I then discuss how I approached conducting the retrospective postphenomenological analysis.

3.3.1. Background of the Guide Dog Teams Study[14] and My Role as a Researcher

As previously mentioned, having the personal experience of conducting the study is an essential part of this dissertation's research effort. I was the principal investigator of the original guide dog teams study, developing the protocol (see Appendix A.1), collecting all data, conducting all interviews, observations, as well as the analysis. The original or initial study was conducted in 2012 and 2013. It followed a human-centered approach to studying people in everyday life through ethnographically-oriented interviews and observations and in order to develop an in-depth understanding of this specific user group (visually impaired people using a guide dog) and from that be able to generate design implications. This is often described as design ethnography (Salvador, Bell, & Anderson, 2010) and related to long tradition of studying people to determine courses of innovation and creation of new technologies to change their lives for the better (e.g., Crabtree & Rodden, 2004; Desjardins & Wakkary, 2013; Taylor & Swan, 2005; Tolmie, Pycock, Diggins, MacLean, & Karsenty, 2002; Wakkary & Maestri, 2007).

More specifics of the methodological approach of the original study are explained in more detail in section 4.2 as well as in published work (Hauser et al., 2014). Additionally, an overview of the study protocol and data collection guide can be found in Appendix A.1 and A.2. Because of my familiarity with the original guide dog teams study and the data that was collected I am able to present this study this way and further engage into reflections on the study and its details as well as in a retrospective analysis using a newly applied theoretical lens.

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[14] Both design research cases (the study of guide dog teams and the field deployments of the table-non-table) engaged with in this dissertation have their own more detailed methodological descriptions embedded in their respective chapters. Here, they are only briefly discussed.

3.3.2. A Retrospective Postphenomenological Analysis of Guide Dog Teams

In the first research case of this dissertation, I engage in an entirely retrospective analysis of guide dog teams using postphenomenology as a newly informing lens. This was an iterative process with several steps and involved trial and error. It also involved me learning how to 'do postphenomenology' and think like a postphenomenologist, yet stay true to my own practice and field's commitments and concerns as that is where this work is situated in. In what follows, I give an overview of these steps. In Chapter 4, I will only describe in detail the last and most productive part (to work towards the goal of this dissertation) of this process.

As a first step, I realized it was necessary to conceptualize guide dogs as non-human mediators representative of mediations similar to the postphenomenological notion of technological mediation. For this I reviewed prior examples of postphenomenological studies and consulted with experts Verbeek and Rosenberger. It turned out, the similarities between the mediations of guide dogs and technological mediation were significant.

As a next step and as a thought experiment, I explored how I would study guide dog teams in an entirely new study using the lens of postphenomenology. For this, I attempted to re-design the original study protocol (see Appendix A.6). However, I came to the realization that I could in fact answer a lot (not all) of the question through my in-depth familiarity with the study data and knowledge about guide dog teams. I was able to re-analyze several specific situations with a new lens making use of my observations and interviews with the participants.

I then began using particular postphenomenological concepts for this new way of analyzing the study data. For this I developed through several iterations guides for my analysis in form of spreadsheets including a guide for an analysis of relational structures in bodily-perceptual handler–guide dog relationships (see Appendix A.3) and a guide for a mediation analysis of guide dogs as transformative mediators (see Appendix A.5 and also Appendix A.4 of a mediation analysis more generally developed as a prior step). Throughout this process I consulted with experts on postphenomenology. For them it was also new to do a postphenomenological analysis of an animal, yet they were very much fascinated by it and in support of thinking about and mentioning the potential advancements this could be for their own field.

Because of the novelty of this exercise, not only for me as a HCI design researcher but also for postphenomenologists I consulted with, this was a months-long iterative process of developing targeted questions for a postphenomenological analysis of guide dog teams. The particular commitments to empiricism differ in the two fields I was and am combining, which also was a challenge to overcome.

For example, I conducted an analysis of the structure and aspects of the relationship between the handler and the guide dog moving through the postphenomenological conceptualizations around bodily-perceptual relationships and additionally by consulting with experts. As part of this analysis of human–guide dog–world relationships, I generated the following final questions:

How do handlers encounter their dog (bodily-perceptually)?

The following subquestions helped to explore this question: *Do they embody the dog? Do they interpret the dog hermeneutically? Do they encounter the dog as an alterity? Is the dog in the background? Where is the dog in relation to the handler? How are they interfacing? etc.*

In a reflective process, I developed answers to these questions annotating the original study transcriptions. This way, I used postphenomenology as a new coding strategy.

For the mediation analysis of guide dogs (as mediators), I first developed two overarching questions which explored existential (i) and hermeneutic (ii) aspects of the mediation of guide dogs: *i. What kind of human subjectivity is created through guide dogs?* This question could also be asked as follows: *How does the dog change the handler's way of being in the world? How does the dog co-shape them as somebody in the world?*
ii. What kind of objectivity of the world is created through the guide dogs? This question could also be asked as follows: How does the dog change the world for handlers? How does the dog give shape to the world as being there in relation to the handler?

I developed more nuanced subquestions to further delve into the two different domains of mediations. These can be seen in Appendix A.5. as well as partially filled in 'answers'.

It is worth mentioning that the goal in this analysis was not to get an entire picture of the mediations of guide dogs or an entire postphenomenological picture of guide dog teams. I could have redone the study to get the full picture, yet this would have been not in support of my

research inquiry but rather an attempt to solve methodological issues which I am not doing in this dissertation.

In support of this dissertation's goal, in fact, I believe it was an advantage not to go back and collect more or new data as I was able to reflect even on the questions I was not able to answer with my data. Some answers were derived from me thinking back at my experience with guide dog teams rather than looking at transcriptions.

3.4. Design Research Case 2: Field Deployments of the table-non-table

The second research case of this dissertation is the midway integration of a postphenomenology-informed inquiry within the field deployments of the table-non-table. The table-non-table is a design research artifact designed to inquire into non-utilitarian aspects of human-technology relations.

In this subsection, I describe the methodological and epistemological commitments of the first research case, the studying of guide dog teams. For this, I first describe my role in the original study and briefly speak to the methodological approach. I then discuss how I approached conducting the retrospective postphenomenological analysis.

3.4.1. Background of the table-non-table Studies and my Role as a Researcher

The table-non-table is a design research artifact purposefully crafted with the goal to inquire into non-utilitarian aspects of human-technology relations. It was designed in a group effort involving several graduate students including myself and our supervisor Ron Wakkary at the Everyday Design Studio at Simon Fraser University over the course of about one and a half years. Involved in this process were many stages including rounds of ideation, research about and decisions on materials, decisions on form and size, rounds of prototyping and lastly the crafting of a final research artifact. I was part of several activities in this process. Furthermore, I lead the deployment studies developing the protocols, recruiting participants, organizing deployments, conducting all interviews and observations, and conducting the data analysis (throughout being mentored by my supervisor Ron Wakkary). In some of these stages, while leading the

deployments I received some help in some parts by other students or colleagues. For example, William Odom collaborated with me on the second of the three protocols and two deployments. He attended three interviews. Gijs de Boer collaborated with me on the third protocol and one deployment.

In recent years, a consensus has emerged that the design of (interactive) artifacts in order to construct knowledge is a relevant and important part of design-oriented HCI research. This development substantiates the idea of using design as a form of inquiry rather than focusing primarily on the creation of innovative technologies (Bardzell, Bardzell, & Koefoed Hansen, 2015; Basballe & Halskov, 2012; Bowers, 2012; Gaver, 2012; Zimmerman, Stolterman, & Forlizzi, 2010). Research through Design (RtD) is a growing generative method within this trend that materially grounds conceptual and theoretical investigations (Gaver, 2012; Koskinen, Zimmerman, Binder, Redstrom, & Wensveen, 2011; Stolterman & Wiberg, 2010; Zimmerman et al., 2007). It enables researchers to learn about how artifacts (they make) shape human experience and further what role the designer and his practice play in this situation.

The table-non-table project uses a methodological approach to RtD called *material speculation* (Wakkary, Odom, et al., 2015) which builds on speculative and critical design. Material speculation involves the crafting of a *counterfactual artifact*—a fully realized system or object that intentionally contradicts what would normally be considered logical given the norms of design and design products. This enables the possibility to empirically investigate how people actually relate to counterfactual artifacts in their own lives.

There are similarities and a mutual interest between RtD inquiries and postphenomenological ones. Both approaches at their core investigate technologies and the relationships humans have with them. Further, RtD offers a promising methodological path to uncovering and investigating mutual concerns of postphenomenology, to look beyond use, interaction, and human-centeredness, to form a deeper understanding of people's experiences and relations with technology. The making and studying of research artifacts provide concrete ways to advance new knowledge on how complexities of human-technology relations can be productively approached (Hauser, Wakkary, et al., 2018; Pierce & Paulos, 2015b; Wakkary, Oogjes, Lin, & Hauser, 2018). Postphenomenology brings powerful analytical concepts to HCI and RtD. RtD, in turn, as an approach and set of commitments holds potential to ground and make concrete postphenomenological concepts.

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Technology field deployments are a common methodology in interaction design research to investigate participants' experiences and interactions over time against the backdrop of their everyday lives (Gaver et al., 2006; Hauser, Wakkary, et al., 2018; Helmes et al., 2011; Hutchinson et al., 2003). Field deployments with RtD artifacts are used to deliver an account of how people integrate and interpret such design artifacts, and how such interpretations challenge normative ideas around technologies (Gross, Bardzell, Bardzell, & Stallings, 2017; Odom et al., 2014). This way of investigating technologies is also aligned with postphenomenological commitments to studying artifacts in real life settings and situations. However, my approach will represent a novel and important shift to directly situating design artifacts in everyday lives, in order to provide a first-hand experience of a future-looking approach to postphenomenological inquiry.

3.4.2. A Mid-way Postphenomenology-Inspired Deployment of the table-non-table

In Chapter 5, I describe the table-non-table study, which entails three deployment study series. In the third series, I adopted a postphenomenological perspective to analyze and surface insights related to the table-non-table. To this end, an in-depth description of how postphenomenology was arrived at as the ultimate framing mechanism in the context of the field deployments, can be found in Chapter 5. In this subsection, I offer only a brief summary to foreshadow my research process for readability.

After I conducted the first two study series, I migrated toward postphenomenology and formed the goal of studying the table-non-table with this theoretical framework. To do this I re-designed the protocol to incorporate more of a postphenomenological thinking (see the transition of the protocol from the second to the third study series in Appendix B.1 and B.2). This protocol was adjusted consistently during the study and challenges I faced along this process are also discussed in more detail in Chapter 5.

3.5. Concluding Remarks

This chapter detailed the methodological and epistemological commitments of this research project, which is of qualitative nature. As such it is creative, exploratory and relying on a

'researcher-designed framework' (Creswell, 2009, p. 19) that is unique to this dissertation. This methodology chapter grounds the following chapters.

Chapter 4.

Design Research Case I:
Studying Guide Dog Teams

Figure 2 Guide dog teams observed 'at work' and 'off work'.

In this chapter, I set out to do an analysis of guide dog teams using postphenomenology as an informing theoretical lens. This analysis is retrospective and grounded in an earlier originally human-centered study and its data; it is also a first step towards the goal of this dissertation to expand upon human-centeredness in HCI design research strategies.

In what follows, first, contextual information on the history of dogs and guide dogs is briefly introduced, in order to conceptualize guide dogs as *non-human mediators* in *human-world relationships*, and to the later postphenomenological re-analysis of guide dog teams. Second, the original *Guide Dog Teams Study* is introduced (section 4.2). It explored routines and interactions among guide dog teams: visually impaired guide dog users and their dogs. The study was conducted in 2012 and 2013 and intended to follow a traditional human-centered

design approach to studying people in everyday life through ethnographically-oriented interviews and observations. The aim of the study was to engage with guide dog owners as a *user group* and their everyday life, in order to develop insights for future technological developments to better their lives. In the third part of this chapter (section 4.3) I engage in the postphenomenological analysis of guide dog teams moving through the structures of emerging relationships as well as the mediating effects of guide dogs. Lastly, I will contrast the differences between human-centered strategies and postphenomenological ways to approaching the studying guide dog teams (section 4.4).

4.1. Guide Dogs as Non-Human Mediators

We have lived with dogs as companions for over 10,000 years and have been creating dogs as we know them, developing several different breeds of dogs for specific purposes for many years (Coren, 1998). Psychologist, dog behaviorist and dog historian Stanley Coren states: "*We have systematically, through seat-of-the-pants, applied genetics, been changing dogs. We have been modifying them to fit our immediate needs and even to fit our technology.*" Dogs fulfill different functions for humans. Probably the earliest function of dogs was that of assisting in hunting activities, with evidence for dogs being used for herding and pulling down game in Paleolithic cave paintings (Coren, 1998). Additionally, Science and Technology Studies (STS) scholar Donna Haraway speaks about prehistorical involvement of dogs helping humans shape their social organization and speaks to their shared traits to technology in a manifesto: *"[Dogs] fleshly material-semiotic presences in the body of technoscience […] are here to live with. Partners in the crime of human evolution, they are in the garden from the get-go, wily as Coyote. […] Dogs are in many ways used instead of a technology, when we train them and utilize the trained functionality*" (Haraway, 2003, p. 4) and "*trained dogs were among the best intelligent weapons systems. And tracking hounds terrorized slaves and prisoners, as well as rescued lost children and earthquake victims*" (Haraway, 2003, p. 8).

Although today most people have dogs as pet companions, there is a large number and variety of working and assistance dogs. Some examples are drug detection dogs, cancer detection dogs, therapy dogs like Reading Education Assistance Dogs or emotional support dogs, autism support dogs, and guide dogs. Assistance dogs are specifically trained to fulfill

specific functions, in which they affect, expand, and change people's abilities, lives, and existence. However, their benefits often go beyond solely utility.

In addition to my own study of guide dog teams, a body of related work (Lloyd, La Grow, Stafford, & Budge, 2008; Miner, 2001; Sanders, 2000; Whitmarsh, 2005; Wiggett-Barnard & Steel, 2008; Wirth & Rein, 2008) helps illustrate key ways that guide dogs actively and directly mediate visually impaired people's actions in and relationships with the world. For example, several studies have specifically looked at the abilities of guide dogs, their benefits and both positive and negative externalities. It seems more appropriate to talk about a constant mediating effect of guide dogs on their owner's lives.

Guide dogs are highly trained animals that provide better mobility and more independent travel abilities for their visually impaired users than the cane (Lloyd et al., 2008; Whitmarsh, 2005). They respond to verbal commands such as "Forward", "Left", "Right", "Straight on", "Find the stairs", and "Find the door", and disregard commands when they could lead to a dangerous situation (e.g., a car backing up out of a driveway or an unsupervised construction site). When human-guide dog teams are traveling together, the human is responsible for orientation giving directions and monitoring traffic and traffic lights; the dog is the guide to staying on track, avoiding obstacles, finding specific destinations (doors, stairs, chairs), and watching out for dangerous situations. There are different guide dog schools that train and provide dogs for the visually impaired. They differ in terms of philosophy, training methods, size and how well they support the dog-human partnership after initial training is complete ("Guide Dogs for the Blind," n.d.). There are currently 15 guide dog schools in the US and Canada accredited by the International Guide Dog Federation ("International Guide Dog Federation," n.d.). A guide dog owner, like any other dog owner, has to provide for the physical and emotional needs of a dog. Dogs need food, several opportunities each day to relieve themselves, grooming, veterinarian visits, playtime and affection ("Guide Dogs for the Blind," n.d.).

Guide dogs are service animals and as such can be perceived or discussed as a service tool. In fact, in several instances guide dogs are being compared to alternative tools including mobility aiding technologies like the long cane or mobility devices and applications. As I will later describe in this chapter, participants from the original study in several cases compared their dogs to the long cane and mentioned the tremendous difference the dogs have made to their traveling and overall lives. Participants mentioned receiving less tactile feedback from their environment. The associated level of concentration and effort is greatly reduced with the guide

dog as a mobility aid. All participants found their dogs very *reliable* as travel aids, with one participant noting they were "*actually more reliable than technology*" [P01]. In addition to that, prior research has also deemed guide dogs as the most beneficial travel aid in comparison to other tools like the long cane.

In addition to being a beneficial mobility aiding tool, guide dogs impact their owners' lives by, for example, shaping their personal confidence and connecting them to their social context. This can be translated into how guide dogs mediate their handler's experiences and existence, and resembles what is being studied as technological mediation as described in postphenomenology. In Chapter 2 I argued that postphenomenology can provide rich and productive analyses of the role and (mediating) effects of technologies in human-technology relations. With that in mind, this philosophical strand with its analytical frameworks can offer valuable insight when applied as a lens to understand the role and effects of guide dogs.

In the postphenomenological analysis of guide dog teams undertaken in this chapter, I conceptualize guide dogs as non-human mediating entities which transform their handlers' experiences and existence. Animals have not yet been studied in postphenomenology, but have been considered as resembling traits similar to technology in postphenomenological works. Ihde (Ihde, 1990) spoke about alterity relationships between humans and technology, mentioning the riding of horses. Another recent account was found in which Secomandi and Snelders (Secomandi & Snelders, 2013) briefly mention specifically guide dogs in the context of an embodiment relationship in their analysis of interface design of services also drawing on postphenomenology. In earlier phenomenological works the long cane was studied as extending sensual perception (Merleau-Ponty, 1945), which I will further discuss in section 4.3.1.

Another example can be found within Actor Network Theory (ANT), an approach that is closely related to postphenomenology, where animals are in fact seen as non-human entities and have previously been looked at. For example, some assistance dogs, including police drug detection dogs, have been studied in ANT (Demant & Dilkes-Frayne, 2015). ANT reframes social theory viewing relations and mediation as being part of networks of human and non-human entities termed actants. ANT and postphenomenology differ in their take on 'relational ontology' (Rosenberger & Verbeek, 2015a, p. 19) with ANT giving up the distinction between human and nonhuman entities, seeing them as symmetrical, and postphenomenology explicitly not doing so. The non-human entity in postphenomenology is "understood in terms of the relations human beings have with them" (Rosenberger & Verbeek, 2015a), which means this

field distinguishes between humans and non-humans but does not separate them entirely. For this dissertation, I borrow the idea of seeing animals as non-humans, however remaining within the utilization of postphenomenology and its underlying concepts as the main framework. I will be looking at guide dogs as a resembling entity of 'a technology' mediating human-world relationships.

This introduction to guide dogs and following conceptualization of guide dogs as non-human mediators, illustrates how the study of guide dog owners and their dogs study opens up well to a postphenomenological analysis and affords to enabling the contrasting of a postphenomenological reading with a human-centered strategic approach within the context of design-oriented HCI. Next, the original study and study findings will be discussed.

4.2. Original Human-centered Guide Dog Teams Study[15]

The *Guide Dog Teams Study* explored routines and interactions among guide dog teams: visually impaired guide dog users and their dogs. It was conducted in 2012 and 2013 and aimed to follow a human-centered approach to studying people (using technology) in everyday life through ethnography-oriented interviews and observations, often described as design ethnography (Salvador et al., 2010). This way of studying people with a central goal to look for potential areas technology could intervene and possibly improve the user group's lives is common in the context of design-oriented HCI. The aim of the study was to engage with visually impaired guide dog users, their routines, and overall everyday life, in order to develop insights for future technological developments to better their lives. The leading research questions of the study were:

What are the routines and tasks of guide dog users and how could the design of new technological interventions help improve their lives?

For the study, a pre-analysis of related works was done consisting of a literature review covering research and practice in HCI and design communities, as well as studies from a range of disciplines outside of HCI. Through word-of-mouth, social media, the Canadian National Institute for the Blind (CNIB) and Access for Sight Impaired Users (ASIC), twelve guide dog

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[15] This part of the chapter is largely based on material that is adapted from (Hauser, Wakkary, & Neustaedter, 2014)

users were recruited; they all lived in or close to Vancouver, were aged between 21 to 67. I also recruited an expert who is a founder of a guide dog school and has been working in guide dog training since 1977.

Data were collected through interviews and observations with the guide dog users, as well as an interview with a guide dog expert. I conducted in-depth interviews and observations with the guide dog users. Interviews were semi-structured and conducted in the participants' homes. Questions were about the guide dog handlers, the dogs and their life, exploring routines, tasks, activities, play and challenges. Moreover, questions targeted the use of and relationship to technology. The observations explored interactions of guide dog teams both in the home and outside. In order to get a detailed understanding of their practices and routines I spent between 2.5 and 4.5 hours with each team, depending on their willingness and comfort. Pictures, videos, and handwritten notes were taken during interviews and observations; interviews were audio-recorded. All field recordings were reviewed and information most relevant to the study focus was transcribed. Through thematic analysis, several pertinent categories within the data were identified. To provide a coherent narrative, findings from both the expert (referred to as X01) and guide dog users (P01-12) are presented together.

4.2.1. Findings

To briefly summarizing the findings, the study revealed strong differences between two distinct interaction scenarios: Guide dog teams are either *at work* or *off-work* presenting very different settings of their relationship. A clear indicator for these modes is the harness, which the dog is wearing while working and typically not wearing while off work. I report on those different scenarios and explore their individual aspects, experiences, and challenges. Further I describe the development of strong bonds in guide dog teams as a pertinent theme.

Two Distinct Scenarios

An important observation segmented interactions between guide dog teams into two main scenarios. They are either working or off work. A clear indicator for these modes is the harness, which the dog is wearing while working and typically not wearing while off work.

Guide Dog Teams at Work

At work, guide dogs wear a harness and guide their owners (see Figure 3). In this mode, the dog functions as an instrument, assuming the role of a working assistance dog. When working, the interactions of guide dog teams are limited. The owner knows where to go, gives the dog commands, and monitors traffic and lights. The dog guides the visually impaired owner safely wherever s/he needs to go, around obstacles and towards steps or doors. Ideally, the guide dog stays concentrated and focused, and does not get distracted. However, guide dogs can become distracted; the handler watches out for this, at times refocusing the dog's attention with a command and possibly an added medium strong leash pull.

Figure 3 Independent travel with guide dogs. Participants walking on the street.

Guide Dogs vs. the Long Cane

The abilities of working guide dogs were highly appreciated by participants, who all used a cane before acquiring a guide dog. During the interviews, they mentioned that traveling with a guide dog instead of a cane is less exhausting. Receiving less tactile feedback from their environment, the associated level of concentration and effort is greatly reduced with the guide dog as a mobility aid. Furthermore, a guide dog opens up more possibilities to engage with other people. For example, consider the following reflection from participants:

> *The dog has impacted my travel tremendously. […] When I think about my route into work. If I had to use the cane, I would need a nap when I got to*

work. It would be mentally exhausting. It is pretty remarkable to be able to travel that way. Pretty neat. [P04]

A cane makes me feel disabled. With the guide dog, I have confidence. [P08]

The dog connects me to people, he is the perfect icebreaker. With the cane, you become invisible. [P06]

Collectively, these reflections highlight how beyond appearing more practically beneficial than canes, guide dogs play significant roles in shaping owners' personal confidence and connecting them to their social context.

Awareness and Confidence Through a Unique Connection

Because of their visual impairment, guide dog owners perceive certain things differently. In a unique way, when working they are aware of their surroundings and confident about their dog's skills. By holding on to the harness, guide dog handlers get information about their dogs by feeling movements. I observed that even minor changes in movement were felt by the owner: while observing, one of the participants (100% blind) noticed a dog far away on the other side of the street just by slight changes in his dog's movement. The observing researcher was surprised since she had not noticed either the other dog or the guide dog movement. In these cases, owners were able to predict moments of inattention in their dogs and react by correcting the dog with a command.

Guide Dog Teams off Work

When off work, the harness is taken off and guide dog teams rest, walk, play, and communicate together. The owner takes care of the dog, providing him with certain privileges that add up to a typical 'dog's life', which includes feedings, several opportunities to go to the bathroom, grooming, attention and interaction (e.g., talking to the dog and giving him affection). Additionally, playing and free running is important. In this off-work mode, guide dogs are similar to pet dogs and have individual behaviors. Similar to the routines of non-visually impaired human-canine teams, the interactions of non-working guide dog teams can vary a lot. Some dogs are more playful and enjoy off-work time to have fun, while others might like to rest more.

Lack of Awareness and Confidence

When off work, guide dog handlers are often unaware of the behavior of their dogs, both inside and outside of the home. In fact, in off-work observations participants seemed to lack confidence in reading their dog's behavior. They often asked what their dog was doing and for

instance whether they were wagging their tail. Often, they mentioned they were not sure of the dog's mood. While conducting an interview in a participant's apartment, he mentioned:

> I don't know what's going on [with the dog] usually he's excited when people are over. [The dog was sleeping at that moment.] [P02]

Figure 4 *Play-interactions of guide dog teams.*

Play

Guide dogs are commonly very playful, due to their breed's (mostly Labrador or Golden Retriever) character. However, there are no special dog toys for blind dog owners. Guide dog handlers end up using dog toys designed for sighted dog owners such as ropes, tug toys, balls, plush toys, squeaky toys, and bones. Play interactions within guide dog teams can vary. In Figure 4 two of the participants can be seen playing with their dogs in their home. In the first picture the participant petted her dog. In the second picture, the participant started playing with a dog toy that she got out of a closet, in which she keeps all her dog toys.

Some of the participants mentioned several challenges with dog toys. First, it is hard to find a toy when the dog is not interested in picking it up or if the toy is out of reach for the dog (e.g., when it happens to be underneath a couch or stuck in a tree or bush). Figure 5 (left and middle) shows two participants searching for dog toys that are right in front of them. I observed several searches like this. Second, participants were unaware of the locations of some of their

dog toys and they were often laying around on the floor as a potential hazard for the blind owner. Some tried to keep toys away or only gave their dog access to a few. Third, I found that all participants had stepped on dog toys before and two had seriously injured themselves as a result. In one case, a participant fell down stairs in her house because of a poorly placed dog toy. In Figure 5 (right), one participant showed me her dog's favorite toy; a bone, which she hurt herself on many times by stepping on the sharp edges when walking around her apartment. Fourth, as mentioned before, dog owners did not notice when their dogs became bored, tired or were no longer interested in playing (e.g., they became busy with other things such as sniffing). This caused confusion for owners, due to the lack of response by their dogs.

Figure 5 Challenges with dog toys: Participants a, b) search for toys and c) shows a toy with sharp edges that led to injuries.

Four participants articulated that they do not see challenges in their play interactions, because they feel they managed to deal with their situation of being a blind dog owner and have adjusted themselves with the situation. However, three of them have sighted friends or partners who often play with the dog.

Free Runs

Guide dogs work hard when they are on-duty. The work needs their full attention and concentration. Free runs are stress-reduction for dogs and guide dogs require them too. As the guide dog expert explains:

> It's stressful being a guide dog. They need stress-reduction. They need free runs. They have to have a life. [X01]

In fact, most guide dog schools tell their students that guide dogs need free running, however, this is one of the most challenging tasks for guide dog teams. Guide dog handlers lack reception of necessary information when their dogs are off-leash. This includes things such as where the dog is, what mood he is in, what he is doing, (e.g., whether he is walking, running, sniffing or going to the bathroom). Handlers might not be able to prevent the dog from running away (e.g., in case s/he runs after a squirrel) and this can be dangerous for both the handler and the dog. The dog could get hurt and the handlers' mobility is dependent on the dog.

Figure 6 Free Running. From left to right: A participant playing with her dog on a soccer field with a sighted person present and two participants visiting fenced dog parks.

Nine participants give their dogs free runs by themselves in different set-ups, four of them outside of their home; they trust their dogs even off-leash. Two of them regularly visit fenced dog parks by themselves (see Figure 6). The remaining five either have a fenced yard or sighted friends or family that help them out. One participant takes her dog off-leash by herself in a school parking lot every day and is confident the dog will not get into trouble because she stated her dog is afraid of cars. Yet after watching the scenario during my observations, I estimated the situation to be dangerous. The dog could have easily run across a street nearby and been hit by a car. Some participants expressed their anxieties of having their dogs off-leash:

> He would be unpredictable. [P02]

> I don't know what he is up to when he is off-leash. It's too insecure. What if he behaves badly and I don't know or what if he walks away and I don't know why. It could be a squirrel he is running after. To be able to call him back at the right time, I need to know what he is up to. [P05]

Free runs need to be done in areas that are safe such as dog parks or big fields without traffic around. For visually impaired owners, it was challenging to find such places, as there are

few dog parks in the location of study (and likely elsewhere as well). One participant called the city and found out there were only two fenced dog parks in the city, but neither of them were in in the area he lives in. In fact, only two of the participants lived close to one.

One participant lived close to a soccer field, and with a sighted person accompanying her; she goes there frequently to give her dog free running. In Fig.4, she can be seen playing fetch. Interestingly, I found her to be proud about her dog retrieving well. Because this play is a routine for her, she gained *trust* in the play and in her dog.

Development of Strong Bonds in Teams

Most dog owners experience a strong emotional relationship with their dogs, often referring to them as a companion or best friend. Most participants felt that the human-animal bond of guide dog teams is stronger than the bond that evolves between sighted owners and their dogs. Three major reasons were mentioned for this: First, guide dog teams spend a great deal of time together. As two participants described it:

> They are with you all the time. You develop a very very strong bond. [...] I spend more time with that dog than people with their children and husbands combined. [P04]

> I consider him my friend [...] I have an emotional attachment. I spend a lot time with him. Almost all day long. That in addition that he helps me get around makes it a strong bond. [P02]

Second, guide dog handlers conceive reliability and trust through their dogs working abilities; this was found to enhance their bond. As an example, one participant said:

> I feel I can rely on him! I really feel I can trust him. [P03]

> I really trust him. You can't have that working relationship when you don't have that ultimate trust. [P09]

Third, participants named the gratefulness and pride for their guide dog's work abilities and their positive impact on the lives of people with visual impairment as strengthening the bond between the dog and the handler.

One participant shared a situation that made him feel both grateful and amazed, because his dog 'managed to make eye contact' with people they had met before and this way helped him to develop a bond with other people.

> I went to a play at a theatre. A man and his wife sitting behind me noticed the [guide] dog. We had a nice chat. A couple of months after, I was at a presentation… [my dog] suddenly pulled me in a direction […] before I knew it, he [had taken] me over to the same people. [P02]

He shared more thoughts on that issue:

> Being blind has the disadvantage that you can't really make eye contact with people. […] The dog is a conversation starter. A friendly dog does make people come over and well, you can meet a lot of nice people that way, even when their initial interest was for the dog.

Another participant echoed that:

> "When you have a white cane nobody says 'oh hi, nice white cane you have', but people will say 'oh lovely dog'. [P12]

Another participant told us a story about when she felt grateful and proud for having her guide dog. She was visiting a mall to pick something up from a store and got lost. She knew malls are difficult for guide dogs to stay oriented in, because they differ a lot from streets. However, her dog found an escalator after a while, which was a difficult task for the dog, but got them out of the situation. After telling the story, she states:

> When he takes me to where I need to go, stuff like that makes me so proud of him, I feel really lucky and taken care of. It makes me so happy that he can be so helpful. That kind of stuff makes me crazy about him. [P03]

Collectively, these reflections illustrate how bonding is essential in guide dog teams, because the handlers have to trust their dogs when they rely on them in work situations. Interestingly, the strength of the bond comes almost entirely through the working relationship of guide dog teams.

4.2.2. Summary and Design Suggestions[16]

The goal of this study was to investigate the interactions of guide dog owners and their service dogs (guide dog teams) to uncover insights and challenges, and to discuss possibilities for future research and design initiatives. The study revealed details about guide dog teams, including major differences in their two distinctive interaction scenarios (at work and off-work). This led to a discussion of possible improvements in their activities through interaction design. As design opportunities to guide future research in HCI I suggested: *harness redesign*,

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[16] Please, refer to (Hauser et al., 2014) for a full description of developed suggestions on designing for guide dog teams

enhanced travel aids, *accessible dog toys*, *interventions to better support free runs*, and *the integration of smart phones*. I also pointed to more speculative and explorative design directions, and lastly discussed benefits of team-centered approaches in HCI research.

In conclusion, the original guide dog team study reached its goals making two core contributions to the field of HCI. First, it advanced the HCI community's understanding of guide dog teams, describing their experiences and challenges, and how digital and non-digital artifacts mediate their interactions. Second, it details several design opportunities and challenges for both interventions aimed at better supporting work and play situations of guide dog teams to help critically frame future HCI work in this emerging area. Moreover, the study contributes to the intersection of HCI, accessibility, and human-canine interaction. Although the testing of actual prototypes with guide dog teams can be seen as a potential validation of some of the discussion points, considering the relative newness in HCI research on guide dog users, the aim was to first offer rich, descriptive findings of the participants' experiences and challenges to inform and inspire new design opportunities, and to nurture this emerging design space to guide future research and practice in HCI. Ultimately, the study makes clear the importance of recognizing the practices, needs and requirements of guide dog teams and the opportunity that the HCI and interaction design community has to positively benefit this group, and more generally human-animal relationships in the future.

In the next section, I further engage with the study of guide dog teams through a retrospective analysis using postphenomenology.

4.3. A Postphenomenological Take on Guide Dog Teams[17]

Commonly postphenomenological studies begin their analyses with particular technological encounters and the structure of human-technology relations at play. They then usually move into an analysis of technological mediations in human-technology-world relations. A postphenomenological analysis of guide dog teams would have a central focus on better understanding the role guide dogs play in the relationship between the handler and 'the world' and analyzing the implications of these roles. The data collected from the original study as well as prior research into guide dogs offers valuable insight into this. In what follows, I turn to an

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[17] This analysis is based on postphenomenological conceptualizations and commitments that I described earlier in section 2.2.2.

explorative investigation of guide dog teams using concepts from postphenomenology. A thorough description of how this analysis was methodologically approached can be found in Chapter 3.

In what follows, I begin the *postphenomenological analysis* by describing the encounters of guide dogs and underlying bodily-perceptual relations. I then describe some of the key mediations of guide dogs.

4.3.1. Encountering the Guide Dog: Structures and Underlying Aspects of Human–Non-Human Relations in Guide Dog Teams

Ihde (1990) argues that humans encounter technologies through four bodily-perceptual relationships: as an *embodiment*, as an *alterity*, through a *hermeneutic*, or a *background* relation. These relationships should be seen as neither exhaustive nor mutually exclusive. Technologies or in my case non-humans like guide dogs can become part of several relationship structures and can further entail relational aspects.

Adapting Ihde's conceptualizations and representations of situating technologies and technological mediation in human-world relations conceptualizing *Human – Technology – World* relations (Ihde, 1990), see also (Rosenberger & Verbeek, 2015a), I can argue that the mediation by non-humans (i.e., technologies or animals like a guide dog) happening in human-world relations can be represented as *Human – Non-Human – World*, and hence the guide dogs' mediation or the relation of a guide dog user (handler) and her guide dog can be represented as *Handler – Guide Dog – World.*

With this in mind, next, I turn to describing the bodily-perceptual relationships in human – guide dog – world relationships in more detail. Questions that I aim to answer in this part of the postphenomenological analysis of guide dog teams are:
How do handlers encounter their dog? Do they embody the dog? Do they interpret the dog hermeneutically? Do they encounter the dog as an alterity? Is the dog in the background? Where is the dog in relation to the handler? How are they interfacing?

Embodying the Guide Dog 'at Work'

In philosophical literature, the long cane is a classic example for a technology that mediates human-world relationships through an embodied relation. It was discussed by a number of

phenomenologists. Initially mentioned by Merleau-Ponty in his *Phenomenology of Perception* (Merleau-Ponty, 1945) actually the long cane was introduced as extending sensual perception transferring it from the hand to the end of the cane. Picked up by Ihde (Ihde, 1979), the example of the cane is discussed as part of an *embodiment relation*, one of four bodily-perceptual relations users can establish with technologies as a means to experience the world "transforming direct perceptual experience" (Ihde, 1979, p. 21).

Both the long cane and guide dogs are *non-human things mediating* blind people's lives, affecting their perceptions, experiences, and existence. There is a lot of resemblance between the two travel aids, yet, as previously mentioned guide dogs have been argued to be the more beneficial travel aid. Similar to the long cane, guide dogs are also a mobility aid of the visually impaired 'through' which the handler perceives her environment. The harness is a key element in this, helping create the embodiment relationship between handler and guide dog. Unique to the use context of guide dogs is that the dog is not touched; it is rather enhanced with the harness, yet still perceived at times as embodied. Through the harness and the specifically trained obedience for utility, a guide dog becomes part of an embodied relation. When the harness is taken off and the dog not working, the embodiment in guide dog teams is no longer at play and that can be accounted for some of the anxieties guide dog handlers' experience.

When working, guide dogs wear a harness and guide their handlers as an assistance dog. The interactions of guide dog teams are limited in work scenarios. The handler knows where to go, gives the dog commands, and holds on to the harness to let the dog guide, while still monitoring traffic and traffic lights. The dog guides the visually impaired owner safely where s/he needs to go, around obstacles or at least notifying the handler about them by stopping for instance at curbs or stairs. The main relation of this constellation is an embodiment relation, in which the handler's experiences and perceptions are reshaped '*through'* the dog and the dog is 'taken into the handler's bodily awareness'. When the guide dog is working, the handler experiences a 'transformed' world or her environment she's encountering in ways 'through' the dog; the person's world or environment is transformed. One participant even expressed how she felt the dog was part of her body saying:

"She is my eyes" [P08].

To give another example that speaks to the embodiment in the working scenario of guide dog teams was when I witnessed how *through* the connection to the dog in harness guide

dog handlers are in a unique way aware of their surroundings and confident about their dog's skills. By holding on to the harness, guide dog handlers get information about their dogs by feeling movements. I observed that even minor changes in movement were felt by the owner: while observing, one of the participants (100% blind) noticed a dog far away on the other side of the street just by slight changes in his dog's movement. I, as the observer was surprised since I had not noticed either the other dog or the guide dog movement. In these cases, owners were able to predict moments of inattention in their dogs and react by correcting the dog with a command. One participant describes the significance of the harness in mediating this unique connection:

> There is nothing that affects our relationship as a [working] team more than the harness. [P11]

Hermeneutic Aspects – When Handlers need to Interpret their Dog's Actions

Guide dog handlers encounter a set of moments in which they have to interpret the dog's doings and behaviours. When guide dog teams are 'working', in a way guide dog owners 'read' their dog's movement in order to understand what is going on in their environment. This relationship directly overlaps with the embodiment relationship, as both can be at play at the same time, during work mode. Generally, there are several movements that will be the same in each guide dog that a blind handler learns to interpret (e.g., when the dog walks around an obstacle or stops at a curb or a staircase). In addition to that, the handler has to learn each individual dog's personality traits and ways of acting (e.g., when different things are encountered) and showing needs or desires (e.g., wanting to go to the bathroom or wanting to play or be petted). Each guide dog acts upon its needs and desires and reacts upon things they encounter differently. As a matter of fact, dog owners who have had more than one dog, assistance dog or pet dog, even if they were from the exact same breed, would agree that every dog is different. Guide dogs and their handlers use movement, touch, sound, and visual clues that will get translated. For instance, handlers do not 'see' what the dog encounters; however, over time, they get a sense of it. An example of that is, when another dog is encountered on the street. The handler will be notified through certain reactions of the dog and can then be attentive to such circumstances.

When guide dog teams are 'off work', their handlers may still need to interpret their dogs' behaviour. For example, a dog may bark at something in the home or in a yard, the dog may whine because it wants to go outside, or the dog may make other sounds that could mean he or she feels playful.

The Dog as an Alterity

When thinking about relations and encounters with guide dogs, a unique aspect about the experience of using a guide dog is that the guide dog is a living being, an animal with an agency, intent, and a personality. Animals are in some ways independent agents in society; and they certainly have intent as live beings. This points to an existence of a nonhuman subjectivity and nonhuman intentionality.

In several ways, each guide dog is unique. The participants spoke about the difference in their guide dogs, some participants already had their third or fourth guide dog. (Guide dogs usually retire when they are around the age of 10 (human) years). When this agency of dogs as living beings comes through, alterity aspects can be described. Animals have personality and autonomy, especially in Western culture this is often endorsed. With guide dogs, this is however, as can be found in the original study, where challenges arise.

Despite the fact that the dog is used as a specific utility and particularly trained for that, individual traits of a dog come through during working mode. When working, the dogs are supposed to be utilized the way they are trained. As mentioned in the previous section, each guide dog acts upon its needs and desires and reacts upon encountered things differently. Often their handlers do not know what the dog encounters. Over time, they get a sense of it though. Still the handlers have to watch out for such instances.

In addition to that, there is a large amount of time in guide dog teams' lives where the dog is not working, therefore not in a harness, and disconnected from the handler. In those moments, when the handler wants to interact with the dog, uncertainty and unpredictability are present and underpin the otherness or alterity aspects of the dog. Some examples of how participants expressed this were:

He would be unpredictable. [P02]

He might never come back to me. [P03]

I don't know what he is up to when he is off-leash. It's too insecure. What if he behaves badly and I don't know or what if he walks away and I don't know why. It could be a squirrel he is running after. To be able to call him back at the right time, I need to know what he is up to. [P05]

The Dog in the Background

When guide dogs are off work and not directly interacted with they can move into the background. For example, when at home, the dog does not wear the harness and is off-leash[18]. Due to the lack of visual perception, the dog's whereabouts can go unnoticed and the perception of the dog's presence can easily move into the background. Yet, even when the dogs are in the background or go unnoticed, they still very much affect their handler's lives.

4.3.2. Towards a Better Understanding of the Mediations of Guide Dogs

In addition to the structure of relations as well as related aspects at play between humans and technologies or non-humans, postphenomenology looks at the accruing implications or *mediations*. Grounded in the previous analytical descriptions around the bodily-perceptual roles of guide dogs in their handlers lives, I now turn towards describing some of the mediations of guide dogs.

Mediations[19] happening on an *existential* level meaning "[h]ow humans appear in their world" or their *actions* and *practices*, and on a *hermeneutic* or *experiential* level meaning "[h]ow reality [or the world] appears to humans" or their *perception* and *experience* (Verbeek, 2005, p. 196). In this, technologies work to *amplify* and *reduce* human perception and experience, and *invite* and *inhibit* human *action* and *practices*. In other words, this part of an investigation focuses on how, in the relations that arise around a non-human, a specific objectivity of the world (to the human) as well as, a specific human subjectivity is co-constituted; and what the implications of that are. In what follows, questions are posed to describe some key mediating effects of guide dogs.

Existential Domain of Mediation: The Co-Shaped Subjectivity of Guide Dogs Handlers

The main overarching question to be asked to investigate existential aspects of the mediation of guide dogs would be: *What kind of human subjectivity is created through guide dogs?* This question could also be asked as follows: *How does the dog change the handler's way of being in the world? How does the dog co-shape them as somebody in the world?*

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[18] There was one participant in the original study who kept his dog tied to a leash attached to a hook on the wall in his living room most of the time. This however is unusual and not recommended by guide dog schools.

[19] Please refer to section 2.2.2 for a full description and illustration Figure 1 of the postphenomenological conceptualizations of mediation.

Quickly and simply answering such questions may involve thinking about the presence and absence of the non-human mediator (guide dog) to make clearer the *mediating effects of guide dogs as transformative mediators*: A human with a guide dog is different than without a guide dog. The human is co-shaped, in other words transformed by the dog. The dog reconfigures what a blind person is (and also reconstitutes the world for a blind person).

Yet, in order to dive deeper into the actual mediations of guide dogs I can further break down the overarching questions around co-shaped subjectivity in guide dog teams, specifically targeting *actions* and *behaviours*, as well as *social practice and engagements* (with the world) based on the mediation analysis approach developed and described in Chapter 3.

How do aspects of the dog mediate (invite/ inhibit) the handler's (individual) actions and behaviors?[20]

Examples of this aspect of mediation within the existential domain include that guide dogs **invite** their handlers to be more independent and to engage in more enhanced travel as well as to be keener to go to more places by themselves, to stay out longer, or do more errands. The handlers' understanding of travel and its possibilities changes significantly through the dog and handlers are **invited** to act on that accordingly.

Furthermore, guide dogs **invite** their handlers to feel more integrated within society and on the other hand often times the feeling of traveling among people, being in public yet feeling very separated and lonely is reduced or **inhibited**.

Additionally, simply having a guide dog be part of a handler's life can **inhibit** them or inhibit them wanting to go to loud places such as concerts or places not well-suited for dogs. Cane users may visit concerts etc. more often, whereas guide dog handlers will maybe simply stay home with the dog or adjust activities. There is a strong invitation or even need to care about the animal's well-being in this.

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[20] Please note that the generated questions and verbs 'invite', 'inhibit', 'amplify' and 'reduce' are based on conceptualizations in postphenomenology specified in 2.2.2 (p.37) when describing technological mediation.

How do aspects of the dog mediate (invite/ inhibit) the social practices of their handler's (on a social rather than individual level)?

Examples of this aspect of mediation within the existential domain include that guide dogs **invite** for more social interaction and engagement. Guide dogs play significant roles in shaping owners' personal confidence and connecting them to their social context. The dog can be considered a conversation starter **inviting** social interaction with other community members. Consider the following quote from the original study:

> *The dog connects me to people, he is the perfect icebreaker. With the cane, you become invisible. [P06]*

Other members of the general public who are encountering guide dog teams are **invited** to start talking to handlers through the dog. For instance, by asking about their dogs. The dog is something many people can relate to. This way guide dogs change parts of the social practice of handlers, as they are in some ways **increasing** their contact to society through the guide dog, and the dog becomes a special connector to society.

Hermeneutic Domain of Mediation: The Co-Shaped Objectivity of the World of Guide Dogs Handlers

The main overarching question to be asked here is: *What kind of objectivity of the world is created through the guide dogs?*
This question could also be asked as follows: *How does the dog change the world for handlers? How does the dog give shape to the world as being there in relation to the handler?*

Quickly and simply answering such questions may involve thinking about the presence and absence of the non-human mediator and contrasting that. The world as it is being perceived by the visually impaired handler is different than the world without a guide dog. The world is different for humans who use guide dogs compared to not having a guide dog. The world as it is to the visually impaired human is co-shaped or transformed by the dog. In other words, the dog reconfigures reconstitutes the world for a blind person.

Yet, again in order to dive deeper into the actual mediations of guide dogs I can further break down the questions around co-shaped objectivity in guide dog teams targeting *perception* and *experience*, as well as social practice and engagements (with the world) based on the mediation analysis developed in Chapter 3.

How do aspects of the dog mediate (amplify/ reduce) the perception and experiences of the self/ the dog/ worldly aspects like environment, material things, people etc.?

An example of this aspect of mediation within the existential domain is that guide dogs can **amplify** the feeling in handlers of being an independent person and more integrated part of society. That way guide dogs reduce the feeling of being alone, being dependent on other members of society, etc. in guide dog handlers. This relates strongly to the previous points about the changed subjectivity of handlers.

How do aspects of the dog mediate (amplify/ reduce) the (individual) perception and experiences of the self/ the dog/ worldly aspects like environment, material things, people etc.?

An example of this aspect of mediation within the existential domain is that guide dogs **amplify** their owner's awareness and confidence through a unique connection and bond. Moreover, guide dogs can **reduce** the feelings of pride, confidence, independence in off-work situations.

Aside from this, I can also use *Rosenberger's field theory* which was explained in section 0 and refers to an expansion of Ihde's notion of transparency (Ihde, 1990) introduced within conceptualizations around aspects of embodiment relations. This field theory attends to in a more detailed way how technological mediation composes and shapes a user's overall *field of awareness*. The three variables *transparency, field composition*, and *sedimentation* are described.

Exemplary questions that are being asked in this part of this postphenomenological analysis are: *What is on handlers' minds? What is happening with the handlers' awareness? What is the experience? What are they aware of? What is present to them, what is not? For example, as they are walking down the street with the dog, what are they occupied by? Being with the dog, what are they thinking about?*

As shown in the original study and described in the earlier parts of this analysis, using a guide dog transforms the handler's abilities tremendously. When traveling using a guide dog, the handler comes to embody the guide dog experiencing large parts of the environment *through* the dog. In this, the relationship between handler and dog restructures the handler's experience of the environment in significant ways. The postphenomenological field theory can help articulate such mediating effects.

The guide dog takes over specific monitoring tasks such as traffic, potentially dangerous situations such as a car backing up out of a driveway, a construction site on a sidewalk, a sidewalk ending, etc. and thereby takes the responsibility of that task and need to be aware of them from the handler. At the same time, the monitoring of the dog is added but much less exhausting for the cognitive capacities of the handlers. The world experienced by the handlers is co-shaped by the environment and the dog.

In terms of *transparency* in the field of awareness in working guide dog teams, an interesting constellation comes to light. While usually the non-human mediators (e.g., a cell-phone embodied when 'on the phone') become more transparent in an embodiment relationship, guide dogs I suggest do not. Based on my observations, I believe that there is actually a low degree of transparency in the handler-guide dog relationship. On the one hand, the safety is highly depending on the dog. On the other hand, handlers are constantly being attentive to the dogs' behavior as although guide dogs are highly trained animals, they have agency and autonomy and have to remain monitored to a certain extend when traveling. For example, behavior from pedestrians or other dogs could distract them. What may become transparent in the process is the harness, which actually connects the handler with the dog and transmits movements of the dog. It is possible that with growing trust in a dog and his or her abilities, the degree of transparency of the dog rises. Moreover, it appears that instead of the dog the environment and surrounding becomes *filtered* and more transparent. While the guide dog is less transparent, the world around the visually impaired handler becomes more transparent or at least 'filtered' or 'reduced' in a way.

Field composition is central and unique to guide dog usage. My initial study data suggests that there is a clear combination of the dog's movement and the handler's audio and sensory sensations comprising the handler's field of awareness. In the typical use situation, when a guide dog wearing a harness is used for traveling, a large part of the awareness of the handler is comprised of paying attention to the dog's movement. The dog's field of awareness covers the monitoring for obstacles while moving on sidewalks or the street. Obstacles could be construction sites on sidewalks or the street, objects like bikes, people, cars backing out of driveways, or the encounter of the end of a sidewalk and steps. Through this coverage, the guide dog could be seen as a *filtering device*, which eases the cognitive demands of the handler. This change in cognitive demand is a huge advancement for visually impaired people as they have more cognitive capacity through using guide dogs as a mobility aid. This

transformations in cognitive demands introduced through guide dogs as a mobility aid speak to what Ihde calls the *magnification/reduction structure* and describes in embodiment relations as they "simultaneously magnify or amplify and reduce or place aside what is experienced through them" (Ihde, 1990, p. 76).

Another part of the awareness of the handler is listening for audio clues to monitor traffic and locations, as well as a sense of what is around, for instance through touch of the feet on the ground to feel the ground material, or whether there is an elevation. Field composition speaks to the way guide dogs reorganize their handler's field of awareness, in that their handler's bodily perceptual capacities are restructured because of changes in their demand that in turn enables more independent travel. This tremendous change and the impact it brings along come to light when comparing guide dogs and the long cane as travel aids.

When beginning to use a guide dog, this new way of traveling and living has to be learned by the visually impaired person. The depth of *sedimentation*, which refers to the sediment of habit associated with a human-technology relation, sets in more with time, experience, and built trust. This also depends on the handler's history with guide dogs—they may be using their first guide dog and may have not had it for a long time; or they may be using their second, third, or even fourth guide dog. When new to guide dog usage, it is a prerequisite that the handler is competent in using the long cane. This is supposed to help with adjusting to a new way of traveling. Furthermore, guide dog schools providing the dog, prepare and train new handlers to accommodate to the new way of traveling. With every dog, there will be a somewhat individual sedimentation process, however, as although they are trained intensely, they are still individuals with individual traits and agency.

Multistability of Guide Dogs: At Work vs. Off Work; use vs non-use

Multistability presents another concept to describe aspects of the relationship between handlers and their guide dogs, particularly the different ways they are experienced by their handlers. Guide dogs are specifically bred and trained for their use as assistance mobility aids. This presents their intended *stability*. The main purpose and aim of them is to provide better mobility and more independent travel abilities to their visually impaired users. This service is provided during work scenarios, as has been discussed. Yet, the wide-ranging impact of guide dogs can also be seen as presenting several additional *stabilities* such as the dog providing company or giving added confidence.

Additionally, because of the nature of guide dogs being a dog or a living beings, they have individual behavioral needs and traits that include resting, feedings, several opportunities to go to the bathroom, grooming, attention and interaction (e.g., talking to the dog and giving him affection) outside of their work. Additionally, playing and free running is important and something that is part of having a dog. Such off-work scenarios can be seen as grounding further *stabilities*. An observation in guide dog stabilities is that in any of the stabilities, the experience of the dog may differ, yet the alterity of a dog will be rather present in any.

4.4. Contrasting Human-Centered and Postphenomenological Ways of Studying[21]

In this chapter, the study of guide dog teams was presented as an interesting case to look at for the relations and mediations of humans and non-humans. The original guide dog teams study which was conducted in a traditional human-centered way was initially introduced. As it stands, it can be seen as successful, producing design implications for future technology developments around use-centered scenarios to improve the lives of guide dog handlers. However, for the purpose of this dissertation's aim to explore complementing human-centered strategies within HCI, the research study case was engaged with through a retrospective postphenomenological analysis.

The postphenomenological analysis of guide dog teams attended with close attention to the different entities and aspects involved in Handler–Guide dog–World relations and mediations. It also revealed that guide dogs are constant mediators of handlers and handler's lifeworlds. Although in the original study I already attended to the connectedness or 'strong bond' between guide dog handlers and their guide dogs by looking at guide dog teams rather than handlers, I did not do this as consciously and informed as I could with postphenomenology. In what follows, aspects of the human-centered and postphenomenological study approaches will be further contrasted.

It is worth mentioning that the point of my postphenomenological analysis of guide dog teams is not to actually get an entire picture of the relations and mediations of guide dogs, but

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[21] This section should be seen as a summary of this case towards the dissertation's goal and a beginning of discussing implications, however, I will pick up on this again and further this discussion in Chapter 6.

rather the point is how an understanding of the relations and mediations of guide dogs indicates a way towards complementing human-centered ways of approaching in design-oriented HCI.

Attending to the Entities in Human – Guide Dog – World Relations

Postphenomenological concepts allow for an in-depth view of the entities involved in human-technology-world relations. In the case of guide dogs this involved the handlers, the dogs as non-human mediators, and the world as it is perceived and experienced by the handlers. This in-depth look at the entities in human-technology-world relations is a useful expansion to traditional human-centered ways of viewing and studying. For example, an expanded understanding of handlers or humans, technology, and their relations can lead to a better influencing of people's experiences and relations to technology through design intervention.

Expanding Focus Beyond interactions

The focus in the original guide dog team study was primarily on interactions and the main outcomes were in support of either work- or play interactions of guide dog teams. Postphenomenology can offer more explicit ways of thinking about how to support guide dog handlers as co-shaped or mediated humans living in a co-shaped world, attending to the nuances of relations and mediations.

The human–guide dog relationship is complex and multi-facetted. Within working guide dog teams the primary relationship structure is an embodiment relation yet with a low degree of transparency and hermeneutic moments in which the handlers have to interpret their dog's behaviours. Due to the dog being an animal, alterity elements or the experience of otherness is a constant part of the human–guide dog relationship. Furthermore, the dogs have multiple stabilities or uses and states of beings as even when they are not 'in-use' they have a presence especially since they are living beings. These nuanced aspects of human–non-human relations are again a productive expansion in focus for design-oriented HCI – a focus on interaction moves towards relations. This also opens up the opportunity for approaching design interventions with relations in mind rather than purely interaction based on utility.

Attending to the Hybridity of Guide Dog Teams

Guide dogs, I found in the original study, are constant and consistent companions in their handler's lives. This especially became clear when participants described details of the tremendous impact guide dogs made to not only their mobility but their overall lives, for example

in significantly shaping their handlers' personal confidence and connecting them to their social context. Engaging with guide dog users' lives and inherently with the relationship between them and their dogs made me view the participants more as human-canine teams rather than solely centering my focus on the human; hence, the name of the study became *Guide Dog Teams Study*. Attending to the strong bond between handlers and their dogs and turned towards studying guide dog teams already challenges aspects of epistemological commitments in human-centeredness.

The kind of relationship and connectedness or hybridity I encountered among guide dog teams was very apparent but unfamiliar when studying what I was used to study: people using services, tools or things, or more generally people in their everyday. My methods, which mainly target human-centeredness and utility, seemed not to be necessarily well-suited to look at the human integrating what the human relates to. But it was an important part of my study and learning about the particular group of people. The human-guide dog hybrid implies an expanded focus centered on a human–non-human team rather than solely a human. In a way, attending to this hybridity, I found that I was moving away from only centering my investigation of the human (human-centeredness) towards de-centering the human, broadening my view as a researcher towards integrating the dog (a non-human [thing] that in part is in service of the human like a tool) and the relations between the human and dog.

However, this analytical move was neither done consciously nor done from the beginning. I found that the postphenomenological approach can help better understand this analytical shift and also give it more substantiation. The human is seen as co-shaped or mediated in postphenomenology. There is a hybridity between the human and non-human. This aligns with handlers' existence co-shaped or mediated by their dogs towards the notion of guide dog teams. In line with this, postphenomenology offers to re-conceptualise the human as a hybrid, mediated, co-shaped entity which de-centers the human yet still takes it serious.

Attending to the Mediation of Guide Dogs

Both my own study of guide dog teams (Hauser et al., 2014) as well as a body of related work (Lloyd et al., 2008; Miner, 2001; Sanders, 2000; Whitmarsh, 2005; Wiggett-Barnard & Steel, 2008; Wirth & Rein, 2008) make clear that guide dogs have a wide-ranging impact on their visually impaired handlers' lives on several levels, including on a functional, emotional, personal, and societal level. I encountered this impact of guide dogs whether they were

'working' or actively 'used' as a mobility tool or not. For example, handlers described how their dogs play significant roles in shaping their confidence and connecting them to their social contextand how that changes their entire life attitude and presence. This presents a kind of impact and change of handlers into new kinds of humans with new abilities, attitudes, and concerns. However, I seem not to be able to elaborately analyze or describe this impact sufficiently through human-centered ways of approaching. More specifically, with the traditional HCI-oriented way of the user study, I was looking at the person and how technology can improve their lives within work- and play-interactions.

Postphenomenology offered to better understand, study, and describe what seemed to be an impact instead as mediations of a guide dog. The theoretical framework also opened up to see better that mediations are widely dispersed across use but importantly also beyond use, utility, functionality as well as happening while being physically connected but importantly also beyond that. Additionally, mediations may derive from intended stabilities through non-intended or non-purpose stabilities.

In comparison, the work and play separation in the original study was very much still focused on interaction and physical togetherness. The postphenomenological notion of mediation is a rather holistic conceptualization that moves beyond interaction and beyond utility providing a deeper understanding of guide dogs and how they shape their handlers and handler's lifeworld or in other words organize handler-guide dog-world relations. It also opens up the opportunity for approaching design interventions in a mediation-centered way rather than a solely human-centered way.

Chapter 5.

Design Research Case II: Field Deployments of the table-non-table[22]

Figure 7 A cat in a household examining the table-non-table.

In this chapter, the second of two design research cases is introduced: The *Field Deployments of the table-non-table*. In what follows I first introduce the table-non-table, a design research artifact made to inquire into non-utilitarian aspects of human-technology relations. I then describe the first two deployment studies and reflections and evolvements within. In this design research case the analytical lens of postphenomenology is introduced mid-way throughout the field deployments performing another deployment informed by the theoretical framework. Third, I turn to describing a third deployment study informed by postphenomenology as an analytical lens and the reflections within that approach. In comparison to the previous chapter and research case which was a retrospect engagement with a study, this case is instead a progression.

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[22] This chapter is largely adapted from Hauser, et al. (2018)

5.1. table-non-table[23]

The table-non-table is a table-like structure made of approximately 1,000 sheets of stacked common stock paper and an aluminum chassis. Each sheet of paper measures 17.5 inches by 22.5 inches with a square hole in the middle to allow it to stack around an aluminum square post. Almost entirely hidden, the chassis holds the paper about half an inch from the floor giving the structure a floating appearance (see Figure 8 and Figure 9). When plugged into an electrical outlet, the table-non-table moves slowly one to two times per day for less than ten seconds. (In an early version, it was moving constantly but extremely slowly, which ended up being too noisy for a home environment and was changed).

STACKED SHEETS
OF PAPER WITH A
SQUARE CUT IN
THE MIDDLE

ALUMINIUM PLATE
WITH POLE AND
CHASSIS WITH
HIDDEN MOTOR

WHEEL

WHEEL

POWER CORD
AND PLUG

WHEEL
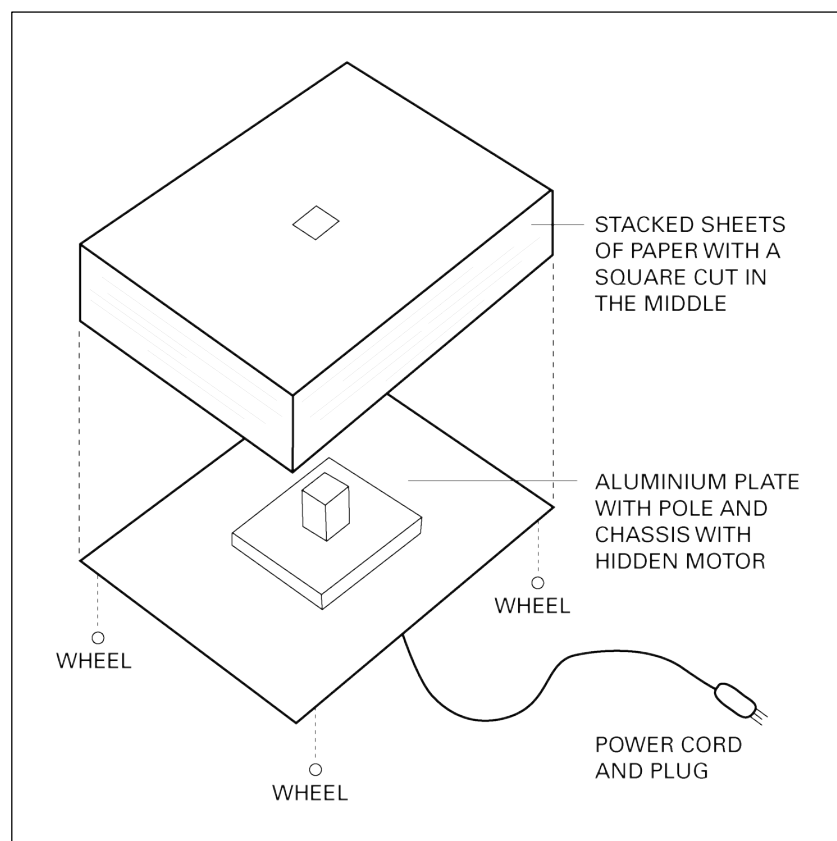
Figure 8 An Illustration of the parts of the table-non-table.

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[23] Please note that the design of the table-non-table was a group effort led by my supervisor Ron Wakkary. All deployment studies were led by me (supervised by Ron Wakkary). I received help in some parts of the deployments from two colleagues, this I described in section 3.4.1. In this chapter, for example if I speak of the design efforts of the table-non-table and other work efforts in which researcher colleagues collaborated with me, I will use pronouns like we and our to depict the collaborative effort behind those parts of the work.
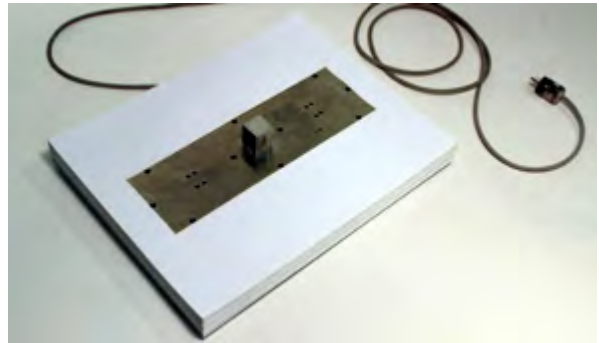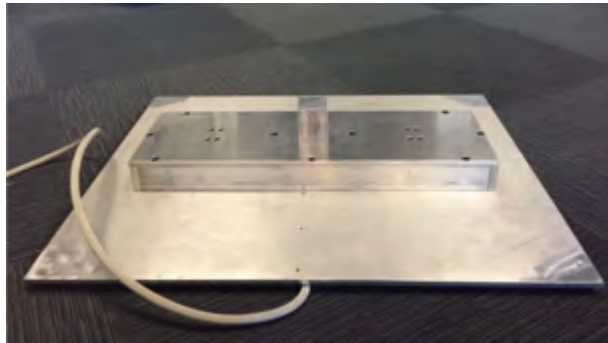
Figure 9 Different views of the table-non-table.

5.1.1. Background

As suggested by a number of scholars (e.g., Zimmerman et al., 2007), reflexive practice can improve design and research methodology. As discussed in Chapter 3, there are significant contributions that can come from the reflexive practice of design and design research. If HCI researchers attend to the practice of design research, and particularly the relationship between theory and RtD artifacts and the ways this informs analysis, it affords a new and different perspective on the critical elements of design research. This underscores the need to provide accounts of practice to reveal that design research is built on diverse approaches and particularities of embodied, situated inquiries and creative actions that inherently resist a

standardization of research practice, not unlike the practices of design. As such, this chapter presents an analysis of the developing conceptualizations and investigations of and with the table-non-table. In a reflexive analysis, I attend to iterations on how the artifact was studied and conceptualized. Importantly, I conclude this investigation by conceptualizing the table-non-table as a *postphenomenological inquiry*.

5.1.2. Theoretical Groundings in the Making

The table-non-table can be seen as a *material speculation*, which is a methodological approach to RtD (Wakkary, Odom, et al., 2015). Material speculation centers on the crafting of a counterfactual artifact to carefully and precisely inquire into research questions. A *counterfactual artifact* is a fully realized system or object that in a use-context may contradict what would normally be considered logical. The goal in designing the table-non-table was to create a technological artifact that would divert from assumptions around use-centric, utilitarian ideas of technologies and design, while retaining subtle design qualities that could enable it to easily fit in everyday domestic settings. The table-non-table was given a specific functionality but which is not in the service of human use. Plugged in, it moves very short distances randomly, a few times a day; when moving, the hidden motor emits a muffled sound. While avoiding specific use goals in the design, as a group designing the table-non-table, we still aimed to craft the artifact in an intentional and purposeful way to give it a finished quality. Elsewhere my colleagues and I have described this approach as *purposeful purposelessness* (Wakkary, Desjardins, et al., 2015) and the table-non-table as a *research product* (Odom et al., 2016). Paper was used on the table-like structure to speak to people's everyday competences as it is a material that is well understood and can be taken up into all kinds of everyday practices (e.g., drawing, writing, folding, cutting, etc.). However, the paper has an unfamiliar format and a square cut in the middle to enable it to be securely stacked on the chassis. Altogether, this design approach combines familiarity with unfamiliarity. It pushes the boundary of what is common or known in terms of utilitarian and symbolic relations to technology that are often guided by established social conventions. Through this unconventional approach of designing and experiencing an artifact the aim was to investigate where boundaries of acceptability might exist with radically new design artifacts.

5.1.3. Inquiring with and Through the table-non-table

Theory plays a significant role in the crafting, studying, and sense-making of design artifacts (Schön, 1983; Stolterman & Wiberg, 2010). The design of the table-non-table was informed by the notion of *everyday design* and conceptualizations of *Theories of Social Practice*. Everyday design (Wakkary & Maestri, 2007) relies on the resourcefulness of home dwellers, the ability to creatively repurpose common artifacts in the home, and an ongoing process of adaptation. The table-non-table, informed by the notion of everyday design, manifests an approach that sees interactive artifacts as resources for creative use and reuse[24]. Through engagement and refinements of the ideas of everyday design, my colleagues and I incorporated concepts of Theories of Social Practice (Reckwitz, 2002; Shove, Watson, & Pantzar, 2012) into our work (Wakkary et al., 2013). A compositional framework of practices consisting of the interrelated elements of materials (artifacts, technologies, etc.), competences (skills, know-how etc.), and meaning (motivations, symbolic value, etc.) (Shove et al., 2012) informed our design propositions that led to the creation of the table-non-table. It steered me towards designing an artifact that could be taken up in practice by speaking to everyday competences through material (paper), while being unfamiliar and not targeted at specific use context (Wakkary, Desjardins, et al., 2015).

In what follows, I mainly focus on the studying and sense-making parts of my design research practice. HCI field deployment methods have been established to test, analyze and evaluate technology prototypes in real-world settings (Hutchinson et al., 2003). They have also been used to make sense of novel research artifacts that break with common assumptions of what a technology is by bringing them into everyday context (e.g., Gaver et al., 2013; Odom et al., 2014). Yet, more is hidden within the novel things we make in design research (Baird, 2004; Gaver, 2012). Design research is often situated in everyday context to make sense of design artifacts, to study how humans experience the existence of artifacts, and ultimately, to surface broader empirical implications from these studies. Correspondingly, my colleagues and I have argued how material speculations are aimed at understanding the empirical phenomena that arise from living with counterfactual artifacts over time (Wakkary, Odom, et al., 2015).

With the table-non-table I set out to inquire into how this radically unique thing could become part of people's domestic life. The unfamiliar aspects of the table-non-table make it

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[24] Parts of this description are adapted from (Wakkary, Desjardins, & Hauser, 2015)

unique but also make studying unknown qualities of the technology a complicated task with HCI methods because they have been developed to investigate the situated (human) use of technology. As a result, methodological and epistemological challenges became central concerns in the inquiry.

5.2. Initial Field Deployments

Over the course of four years, I engaged in iterative field studies, reflections, and conceptualizations that, over time, helped me to better make sense of the table-non-table and the relations that emerged with and through it. Next, I describe details and insights that emerged across this trajectory of research. This account is guided by the questions:
How are theory and design enacted together in this RtD project? How does theory inform how we/I study and make sense of the artifact?

In the research with the table-non-table I conducted a long series of field deployment studies. Between December 2013 and June 2017, it was deployed in people's homes in the Greater Vancouver Area, BC, Canada through three study series with six different case instances (#1 - #6). In what follows, I briefly summarize each case, reflect on each series, and offer insights into the trajectory and iterations of the study series.

5.2.1. First Series: Letting the Thing Do the Talking

As an initial step, I put the table-non-table into three different homes. Two were brief *self-deployments* in households of members of my research group (summarized under #1) and one was a 6-week deployment with a professional couple unfamiliar with the artifact (#2).

Theory and Protocol

Informed by everyday design and theories of social practice, the aim was to get to know whether the table-non-table could be taken up in people's domestic practices. In this endeavor, I was *letting the thing do the talking.* The table-non-table was first placed into the homes of members of my research group. Photographs were taken. Additionally, the table-non-table was deployed with a participant couple who were instructed to share experiences and images on a private blog with the researcher acting as a silent*,* remote observer.

The leading research questions of this study series were:

Will the table-non-table find a place in a home?

How could the table-non-table be taken up in people's domestic practices?

#1 Two Researchers' Homes – For a Few Days – 2013

In this deployment, two members of my research group lived with the table-non-table for a few days (see Figure 10). This step was to get a sense of how it could possibly become part of domestic settings and practices. Documentations of the table-non-table in their homes were later discussed and analyzed in our group.
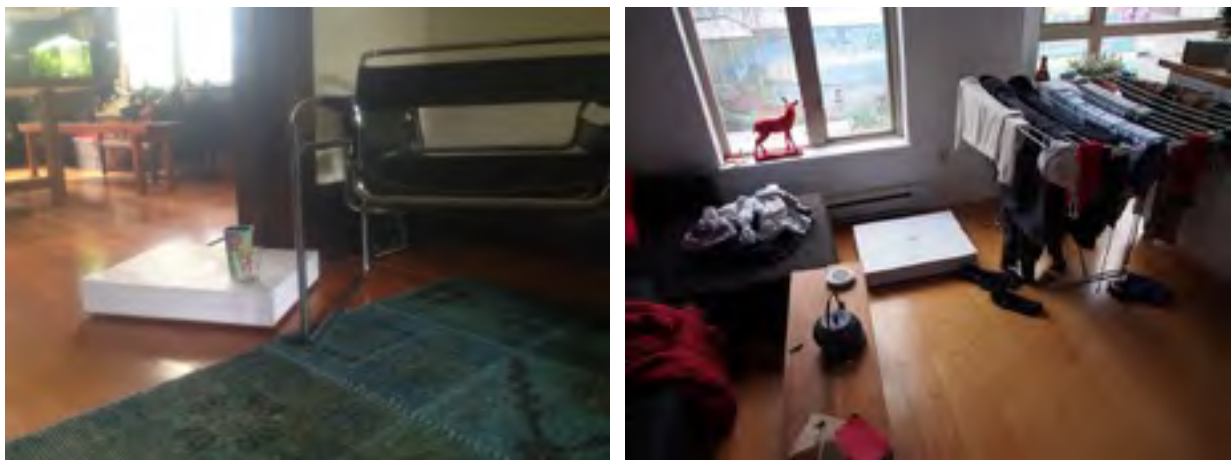
Figure 10 The table-non-table placed in two homes.

#2 Participant Household – For 6 Weeks – 2013/14

As a second step in this study series, the table-non-table was deployed with a professional couple for six weeks. Todd and Marie were working in landscape architecture and were recruited by referral (all names used in this paper are pseudonyms). I simply asked them to live with 'a prototype we designed', not mentioning any other details. I asked them to report on their experience through photographs and text entries on a private Tumblr blog that I set up for them. I primed them with these questions*: How do you use the prototype? What do you think about the prototype? What does it make you think about? How does it affect your life?* I received four text entries and 16 images from them (see a part of the participant's Tumblr blog in Figure 11).
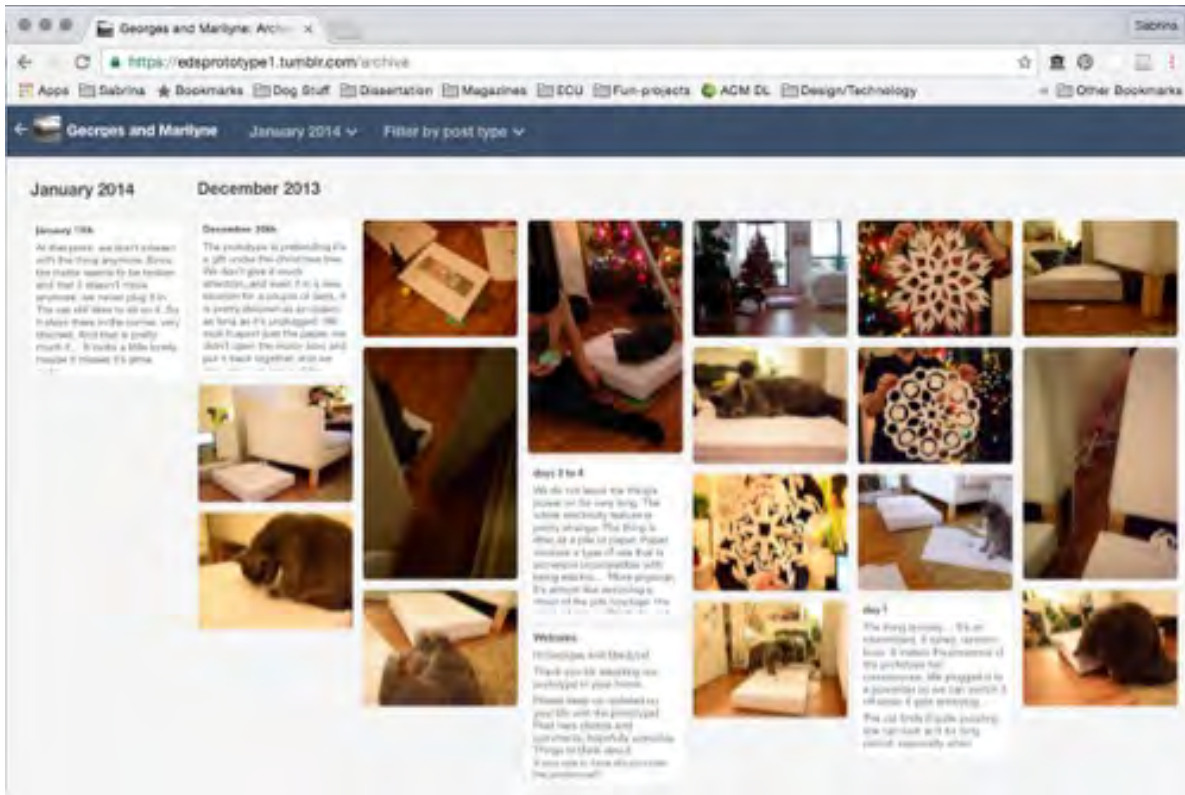
Figure 11 Private Tumblr blog archive of participant household #2.

Study Findings

In the first study, the table-non-table was placed in the living room of two homes for a few days only. For us as a research team—and this came out in discussions—it merged with the rest of the home. In deployment #2, the participants engaged with the table-non-table in numerous ways. The participants had a cat that immediately began investigating it: *"day 1:* […] *The cat finds it quite puzzling, she can look at it for long periods, especially when* [and after] *buzzing. A big fan of paper, she also chewed the corners and took a couple of sheets off the thing. Marie and I haven't figured what to use it for yet".*

Later, the cat engaged further with the paper, ripping and chewing it, and using it as a bed (see Figure 12). The cat's playful interactions with the artifact invited the participants to use the paper themselves. Since it was around Christmas, they made snowflakes (see Figure 12). Early on, Todd and Marie plugged the table-non-table into a power bar in order to better control its buzzing sound. (Note, in this early version the table-non-table was always moving, emitting a

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constant buzzing sound. This was changed after the first series). In summary, the table-non-table found a place in the different homes and was taken into several domestic practices by the participants (and their cat).
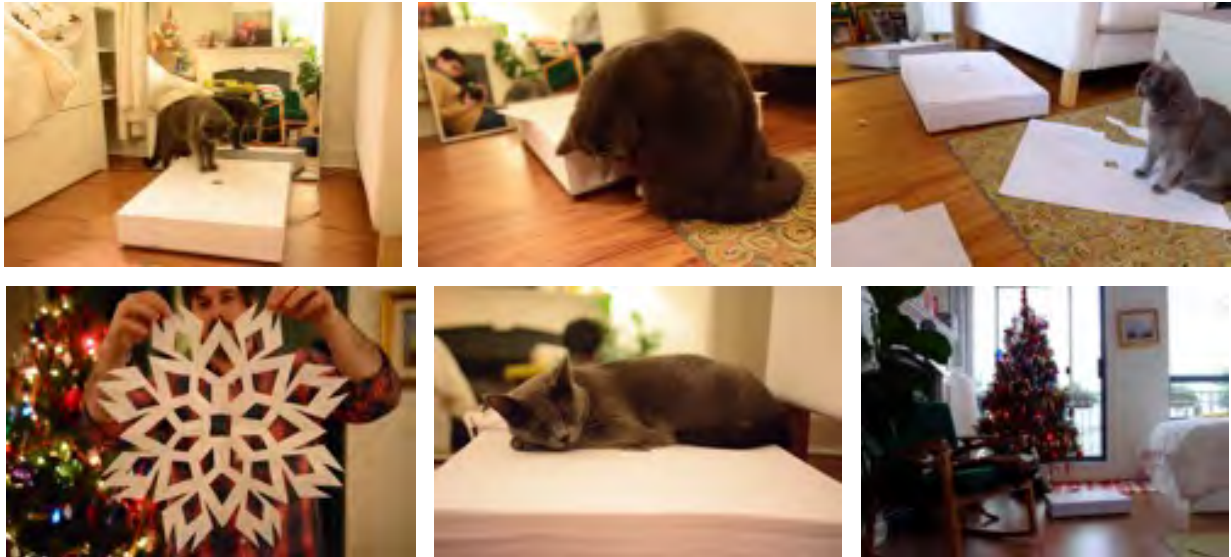
Figure 12 The participants' cat playing with the table-non-table and participants making paper snowflakes. The table-non-table next to a Christmas tree.

5.2.2. Meta-Reflection and Shift in Theory

Through this first series of deployments, I began to see how the table-non-table could become part of domestic settings and everyday practices. The paper was used for crafting snowflakes and the cord taken up into the practice of plugging in and as a way of controlling sound. With the theoretical frameworks of everyday design and social practice dominating the initial conceptualizing of the table-non-table as an object with qualities speaking to domestic practices, I initially considered the deployment as a success. However, I felt unsatisfied with the knowledge this generated on the unknown aspects and relations coming about through the table-non-table in domestic settings. In further post-study reflections, I began to think about the setting of the participant's homes. I contemplated whether the table-non-table was 'a good fit' in their home, which led to a first theoretical shift. My colleagues and I began to investigate 'fit' as a concept for research artifacts in the home; and wondered whether it was possible for the table-non-table to achieve *fit*. Christopher Alexander's description of *goodness of fit* and his idea of *unselfconscious culture* (Alexander, 1964) resonated with me after conducting the first series. Alexander describes the process of incremental and unknowing interactions and corrections that

lead to improvements in everyday life—what he refers to as *goodness of fit*. The combination of the unknowing nature of the interactions and that the 'design' is done unknowingly (i.e, not by professional designers) led Alexander to refer to the process as *unselfconscious*.

I critically assessed the findings and study approach, prompting me to recognize the need for a more thorough account of the lived-with experience with the table-non-table and to inquire more into the human perspective. Ethnography is what I knew (traditionally) could get me there.

5.2.3. Second Series: Ethnographic Accounts of Living with the table-non-table

As a next step, the table-non-table was deployed in three different participant households: once for six weeks (#3) and twice for three and a half months (#4, #5).

Theory and Protocol

Informed by Alexander's notions of *goodness of fit* and *unselfconscious cultures*, in the second series of deployments, I wanted to get a better grasp on the participants' lived-with experiences with the table-non-table and to inquire into the fit of it in their homes. In order to get such an account from the participants, I migrated towards using established HCI-oriented ethnographic methods (cf. Hutchinson et al., 2003; Maestri & Wakkary, 2011; Odom et al., 2014) to guide the investigation.

The leading research question of this study was:
How does the table-non-table fit with people's homes and what are the people's lived-with experiences with it?

Together with one colleague (William Odom) I developed a protocol for ethnographically-oriented interviews to inquire into the participants' experiences. At the drop-off, we inquired into the participants' everyday routines. With the table-non-table deployed, participants were invited to live with the artifact and do with it whatever they wished. They were also asked to report thoughts and experiences on a private Tumblr blog, which I set up for each household. At the end of the deployments, we conducted one final interview with each of the households. We mostly asked about activities related to the table-non-table as well as thoughts and critical explorations on its behavior. We also inquired into tensions and thoughts on aesthetics and

material qualities of the artifact, comparisons to other technologies, reactions to the table-non-table's *otherness*, as well as complications and difficulties over reconciling what it 'is' and what it is supposed to 'do'.

#3 Participant Households – For 6 Weeks – 2014

For this deployment, I recruited a family in Vancouver, Canada. The Kensingtons were a family of four including two adult sons (28 and 30 years old) and a dog. I asked them to live with the *research prototype* (not mentioning its name or what it does, i.e., that it moves) and to report back what they thought of it and did with it. They shared seven photographs and four written long reflections. The participants were visited for the drop off, a midterm interview, and a final short interview and pick-up.

#4 Home of Two Researchers – For 3½ Months – 2014/15

To be more informed about the lived-with experiences with the table-non-table for longer than six weeks, I put the artifact in the home of two members of my research group (Lisa 31 and Johnny 32 and their cat and dog) for three and a half months. Lisa and Johnny shared 19 photographs and 12 short text entries on their blog and were interviewed. This self-deployment influenced the following deployment.

#5 Participant Household – For 3½ Months – 2015

With a slightly revised protocol informed by the previous deployment, I set out to deploy the table-non-table with a family with young children which I recruited through flyers distributed through various channels. The Wentworths received one from a friend and contacted me. They are two adults and five children (5-year-old twin girls, a 9-year-old girl, a 10-year-old girl, and a 12-year-old boy). I conducted an initial interview at the drop-off and later a final interview. The Wentworths shared 12 photos, one video, and nine short text entries on their blog.

Study Findings

In addition to being visited and interviewed, all participant households shared photographs of the table-non-table in their home and text entries with reflections, thoughts, and descriptions of interactions with it. In #3, each of the Kensington household members spent considerable time engaging with the table-non-table or 'papier machine' as they named it (inspired by the French word). These engagements include both direct interactions with the table-non-table and more reflective contemplation over what its purpose is, and more generally what it is. Interactions

consisted of tinkering with the paper, getting guests to 'sign it' like a guestbook, moving it to different parts of the house, and inviting or encouraging their dog to play with it. Other reported experiences included casually walking past it and taking note that it had (or hadn't) moved. Ms. Kensington often noticed the sound and movement of the table-non-table when working in her office next to the living room (where it largely resided). What was most clear in interviews with the Kensington's was that the table-non-table occupied a tense and somewhat frustrating place within the household. In several instances, Ms. Kensington described how it made her feel "inadequate" in that she had not resolved what it is supposed to do and why (a common sentiment held by other household members): *"it 'demands' your attention because its purpose and functionality are unclear, so it requires a good amount of 'work' to figure out what it's supposed to be for, or to figure out a new use for it* […] *It seems like a lot of bandwidth will have to go into* [figuring it out]*."* After four weeks, they put the table-non-table aside under a bed. It seemed to me that the Kensingtons would have needed more time to achieve a better fit for themselves. I therefore decided to put it in one of our own homes again but for longer than six weeks, and then do another deployment with another participant household.
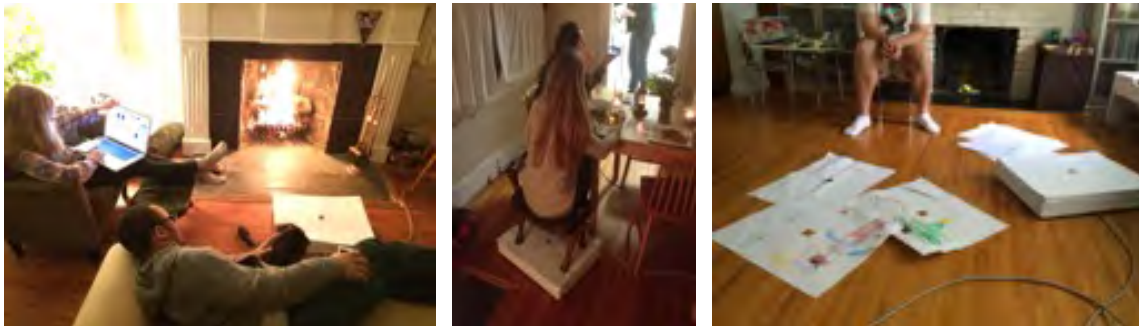
Figure 13 The table-non-table in households #4 and #5.

In #4, I created an autoethnographical account of living with the table-non-table. In this household, it was placed in the living room in front of a fireplace (see Figure 13) and used in various ways; once as a stool extension, and in several occasions with their dog and cat. The paper was used for the fireplace and to wrap a present. After two months, it was moved in the background underneath a magazine stand next to the couch until it was removed. In #5 the table-non-table was investigated by taking the paper off to see what's 'inside', used as a performance stage by the children, the paper for drawings (see Figure 13), and to create snowflakes. After two months, it was moved into the closet.

Across these deployment studies, there was an initial phase of excitement, followed by an exploration centered on use, and a reflection on whether or not the artifact fits in one's home. This latter stage could entail frustration over not being able to make sense of it, and ended in putting it aside.

5.2.4. Meta-Reflection and Theoretical Conceptualizations:

Christopher Alexander's description of *goodness of fit* and his idea of *unselfconscious culture* (Alexander, 1964) led me to inquire into people's lived-with experiences with the table-non-table (Wakkary, Desjardins, et al., 2015). The ethnographic approach steered the investigation from a strong focus on the artifact (first series) towards looking closer at details of participants experiences. This ethnographic approach focuses much more on the human—in this case, on the participants and their human-centered experiences with and perception of the table-non-table. The way the participants tried to make sense of the artifact was through use-centric explorations and thoughts around it. However, since the table-non-table is designed to be purposeless, trying to make sense of it through use-centric methods was not fruitful. However, on a theoretical and conceptual level, these insights shifted our thinking more clearly away from use toward the broader set of human-technology relations.

Successful Theoretical Conceptualizations[25]

Grounded in the investigations of my colleagues and I on Alexander's notions of 'goodness of fit' and 'unselfconscious cultures', we theoretically developed *unselfconscious interaction* (Wakkary, Desjardins, et al., 2015), a *conceptual construct* (cf. Höök & Löwgren, 2012) that describes a form of interaction with computational artifacts animated by incremental intersections that lead to improvements in the relationships among artifacts, environments and people. It is a *construct* that is comprised of the motivation of goodness of fit that is supported by two design qualities we named *open-endedness* and *lived-with*. *Open-endedness* shifts the nature of the interaction design artifacts to be resources for new and unknown interactions or intersections rather than prescribed means to an intended interaction. *Lived-with quality* supports the idea that unselfconscious interaction requires time to emerge and take shape. The idea in terms of design is to consider the experience of living with an interaction design artifact

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[25] Parts of this section are adapted from (Wakkary, Desjardins, et al., 2015) where my colleagues and I explain the conceptual construct of Unselfconscious interaction and related concepts in detail.

similar to how someone might live with furniture or even simple items like a ceramic bowl or a lamp for years, possibly decades or even a lifetime. Such artifacts become resources with which humans co-inhabit and jointly dwell within environments.

Through this lens, we were able to describe the design of the table-non-table as an interaction design artifact that emphasizes actuality over functionality, having neither an explicit interface nor computational awareness of its owner's presence or actions. We termed such interaction design artifacts as *unaware objects* and some of my colleagues further described the concept of *unawareness* (Odom & Wakkary, 2015). Moreover, my colleagues and I further developed a notion of non-functional engagement with design artifacts, which we termed as *intersections.* Intersections refers to the unknowing or unnoticed crossing of paths of artifacts and people in which a manipulation may or may not occur. Unlike engagements and interactions, intersections lack awareness or knowing of the relationship between person and artifact. The construct of unselfconscious interaction encompasses engagements, interactions, and intersections (Odom & Wakkary, 2015; Wakkary, Desjardins, et al., 2015).

We found that as intersections accumulated around unaware objects, dynamic configurations of artifacts, context and human actions emerged, which we refer to as *ensembles* (Odom & Wakkary, 2015).

In this part of the investigation, the existence of the table-non-table enabled the development of a more nuanced understanding and vocabulary around non-utilitarian notions of interactions.

Wrestling with the table-non-table and Theoretical Enactments

In the design of the table-non-table, several aims come together with the most common or normative ideas about a technology being either weakened or lacking entirely. The generative stance to theory complemented this approach of wanting to investigate design research artifacts as alternatives to existing assumptions and utilizing theory as a starting point with the aim of moving past the normative framings of the theories themselves. Even though in theoretical conceptualizations I felt my colleagues and I were successful, the way of inquiry did not seem fully appropriate. I was getting at information and generated knowledge from the studies, but it did not seem adequate to inquire with traditional, largely use-centric ethnographic methods into concepts like unawareness, intersections, and ensembles.

Another Shift in Theory: Migration Towards Postphenomenology

After the earlier deployments #1-5, I brought the table-non-table back into our research studio and placed it in front of a couch where it seemed most fitting given traffic of people and the floor space. We kept it plugged in and lived with it this way for over 16 months. Although not a direct deployment, over this time period studio members experienced living with the table-non-table in their work space and I used this time to continue reflecting on it.

During that time and initiated through personal interest, HCI developments (e.g., Verbeek, 2015; Odom et al., 2009) and collaborations, I migrated towards the postphenomenological school of thought and its underlying understandings of technologies and human-technology relations[26]. As previously mentioned, this strand of philosophy aims to understand the role technology plays in human existence and experience, viewing technologies as *mediators* of human-world relationships. It provides salient insight on technologically mediated situations in everyday life, placing emphasis on a holistic and comprehensive look at humans, technology, and the world. Postphenomenological investigations are empirically grounded and focus on real world cases, which I see as in line with my own research practice.

5.3. Third Series: A Mid-Way Integrated Postphenomenology-informed Inquiry

As a third step, the table-non-table was deployed once more in a new approach with one household for 11 weeks.

5.3.1. (Early) Protocol and Theory

Postphenomenology begins its analyses with particular technological encounters and their structure of human-technology relations. It then usually moves into an analysis of technological mediations in human-technology-world relations. Ihde, a key pioneer of the postphenomenological school, argues that humans establish a range of bodily-perceptual relationships with technologies (Ihde, 1990), encountering them as an *embodiment*, as an *alterity*, through a *hermeneutic* relation, or as a *background* relation. Verbeek (2005) describes

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[26] A more personal account of the background and motivation on why and when I migrated towards postphenomenology during my PhD studies is given in section 1.3.

mediations happening on a *hermeneutic* or experiential level and on an *existential* level; the former detailing "[h]ow reality appears to humans" or humans' perception, and the latter "[h]ow humans appear in their world" or humans' action (Verbeek, 2005, p. 196). With postphenomenology informing my thinking, I set out to inquire about a holistic account of the table-non-table taking into account the relations occurring with it as well as underlying and emerging qualities, aspects, and implications of those relationships. Together with one of my colleagues (Gijs De Boer) I engaged in another deployment with the aim to let postphenomenological commitments guide us. We initially stuck with an ethnography-inspired approach as that is what we knew and there were no guidelines on how to do a postphenomenological empirical study with a technology like the table-non-table.

Unlike previous deployments, we explained in full to the participants the nature of the table-non-table and the research study to remove any guessing about the artifact or study. We asked the participants to use a private Facebook group blog to report images, videos, thoughts, and questions. I chose this medium because it was most convenient for the participants.

The deployment consisted of a drop off with a short interview, an interim interview, and a final interview. We also developed priming exercises for the participants to engage with specific themes like 'fit' or 'paper as a material'. We shared those on cards by either bringing them along or presenting them on the blog. The initial interview focused on gaining an understanding of the participants, their beliefs, and their everyday routines. This we did to later have reference points to relate mediating aspects to that in the analysis. We asked about their home, life, the role of things in their life and their attitude towards them. We left them with the request to give the table-non-table a place in the home for the duration of the study (11 weeks).

#6 Professional Couple Household – For 11 Weeks – 2017

The last participants were Amy, 30, an industrial designer and Tom, 34, an architect, who I recruited by referral.

5.3.2. Initial Study Findings

Amy and Tom live in a small urban apartment and are serious about not keeping too many things in their home. Similar to previous participants, they tried to make sense of the table-non-table by determining what it could be *used* for and how that compares to ways of using other

things. Their trained background in user-centered design also had an effect on that. Tom described: "*the role of the designer and ethical responsibility to create objects that add value to people's lives stands in contrast to making objects to sell things or add meaningless things to people's lives*[…]*you see it all the time with stupid apps.*" For a while, Tom felt I was testing their reaction to a meaningless object added to their life.

Figure 14 Pet rats Cheeky & Chewey engage with the table-non-table.

Their two pet rats immediately took advantage of the table-non-table when outside of their cage. This resonated well with Amy and Tom. Apparently, it is valuable for rats to have new things in their environment to interact with. "*Cheeky loves a crinkle tunnel. He took paper inside there*" (see Figure 14). "*He* [also] *created a tunnel with the table-non-table's paper and peeked through the 'window'* [the cut square]*"* (see Figure 14). Chewey, the other rat, continually dragged sheets of paper underneath the couch and into a corner, where he ripped them in pieces to create a little nest. Tom put paper on the top of the cage for them, a place where they could not reach it. In addition to being a toy for the rats with odd features, however, Amy quickly and consistently felt strong about rejecting the table-non-table, that is, she did not know what to use it for and argued that therefore it was a bad design and that she would not know what to do with it.

Initially, it was tough for me, as a design researcher, to have the participants reject the table-non-table or see it as a badly designed rat toy; in this study, especially so explicitly and quickly within the study period. At some point, Tom and Amy stopped engaging with the priming exercises. They did not feel there was any purpose given the uselessness of the table-non-table. Nevertheless, in the second half of the study, after the interim interview, I began to see past these initial tensions.

5.3.3. Overcoming the Focus on Human-centeredness & Useful Use

As a researcher, I found it harder than expected to shift away from the human-centered orientation in our ethnographic ways of studying. I had to overcome the strong focus on 'useful use' (by the participants) and look at the study more holistically. I had a keen sense that postphenomenology could support this endeavor because it emphasizes a holistic understanding of human-technology relations. Yet, this theoretical framework is not normally used to analyze unfamiliar technologies, like the table-non-table, that do not have social norms established around them. After two weeks, I had invited the participants to explore the idea of *using* the table-non-table, which caused me (and them) to slip into exploring its relations and mediations with 'use' as a starting point.

Ultimately, the design of the table-non-table, the participants' rejection of it that was based on useful use or utilitarian aspects, and, in turn, the overcoming of that rejection with a postphenomenology-informed framing led me to the deeper realization. The relations humans have with things and technologies may not solely be based on or begin with 'use'. As soon as an artifact becomes part of a home, whether in front of a fireplace or under a bed, it shapes a new reality and mediates people's existence and experience regardless of the perception of its usefulness. It will co-constitute particular human-technology-world constellations and a certain subjectivity and objectivity dynamic, even in the case of the table-non-table. I had to critically reflect on and take into account that postphenomenological inquiries typically look at available user-centered technologies. Through the design and deployments of the table-non-table, the research team broke with this kind of normative approach to designing technology and their human-technology relations.

5.3.4. Further Developed Protocol

In the interim interview with Amy and Tom I discussed with them the location, behavior, and fit of the table-non-table in their home. I also talked with them about their impressions on 'use' which led to a conversation around *indirect use* and subtle ways the table-non-table could be having an impact on their everyday life. In the final interview, I further explained how I was looking at relations, perceptions, actions, and practices that do not revolve around functions for human use. I characterized the table-non-table as part of a background relation and other things occupying the participants' background, such as a waffle iron in their cupboard. This catalyzed conversations about things in the home that serve no immediately apparent function.

5.3.5. Further Findings: Rejection of the Participants' Rejection

Up until the final interview, the participants mainly rejected the table-non-table, which was largely based on their assumptions of it being useless. After the interim interview, it became more and more apparent to me that the table-non-table had subtle mediating effects on Amy and Tom's life. Shortly after the drop-off, Amy felt there were too many things in a corner area in her living room. She moved the table-non-table underneath the side cabinet and moved the lamp. She later got rid of a decorative typewriter and a yellow chair she had possessed for years. Amy and Tom seemed to become more reflective and aware of the things in their living space. After being asked whether she thinks the table-non-table influenced her movement and dispossession of belongings, she replied: *"it may have."*

Paper as a material also seemed to spark reflection: *"there's something to be said about paper. There's nothing that can replace the analog. […] If I had only one medium, it would be paper […] you can build things with it, […] like structural forms just by folding […] it's the ultimate."* Amy also pointed to a documentary about paper she had seen, and shared more about her personal background growing up in a small remote town without many belongings. In her youth, she was able to express herself with pencils and a sketchpad, which she saw as all that she needed. She still has her first sketch book. Amy then remarked about the table-non-table: *"If you focus on this, the element of paper, and the relationship to paper, and have that be the focal point I think that the whole product could change and it could be of value."*

5.3.6. Meta-Reflection and Final Theoretical Conceptualization

Grounded in postphenomenology, I developed a holistic understanding of the artifact and its mediating effects. The relations that developed between the participants and the table-non-table however, were unlike any kind of interaction with technology I was more familiar with studying. Next, I describe a postphenomenological account and conceptualizations of the table-non-table that I arrived at through the last study.

A Postphenomenological Account of the table-non-table

Technologies mediate between humans and the world, changing or re-organizing a person's experience amplifying some aspects of perception and reducing others (Ihde, 1990) and changing the environment it becomes part of—even a technology seemingly useless as the table-non-table. I was able to detect this in the last *mediation-centered* study by actively looking beyond use-centeredness to bring the nuances of human-world relations mediated by the table-non-table into focus. This also made clearer why the more use- or human-centered approaches of the earlier studies did not uncover these mediating effects.

Human-Technology Relations

The closest known technology similar to the table-non-table is a coffee table or side table, hence the name. From a postphenomenological view, tables in homes usually are encountered through *background relations*, which are at play when a technology is operating but not occupying or calling for focal attention. Nevertheless, it is still shaping people and their experiences (Ihde, 1990). Ihde refers to this as 'absent presence'—when a technology is not directly used but still being experienced, becoming "a kind of near-technological environment" (Ihde, 1990, p. 108). Technological mediation of background technologies works often through their "indirect effects upon the way a world is experienced" (Ihde, 1990, p. 112). Verbeek (2005) describes dining tables, when absorbed into the practice of eating, as actively shaping a certain culture around eating, communal behavior, making conversation, and hierarchy. Yet, the table-non-table does not fall into the category of the 'familiar' technologies that are nearly always at the center of postphenomenological analyses.

Although seemingly designed to be in the background, upon entering a home the table-non-table catalyzes or introduces unknown and uncertain relations that participants try to understand and make sense of. Unlike typical background technologies (e.g., a refrigerator), the

table-non-table puzzles people and thereby asks for attention when it occasionally moves without a recognizable reason or function. Over time, the unique nature of the table-non-table emerges through the background to find a place in everyday life. The rejection, friction-laden path that I saw in the deployments can be seen as similar to what Rosenberger (Rosenberger, 2012) refers to as *sedimentation*—the habits that emerge with a given human-technology relation can reveal the subtle and diffuse mediations that go well beyond use and instrumentality. I see this as the very point of the table-non-table.

Mediations or Co-Constituted Subjectivity and Objectivity

I learned that even if not directly used or seemingly useless, a technology like the table-non-table still shapes the environment and lives of people living with it, albeit in subtle or weak ways. It co-constitutes a particular reality and human *subjectivity* and *objectivity* of the world. In hindsight, this appeared to be the case for all participants. For example, while trying to make sense of the table-non-table, Amy reflected on its materials, i.e., paper, and what it means to her. Amy and Tom also engaged with the space in their apartment by ridding themselves of some furniture. Regardless of where it was placed (e.g., in the living room, closet, or underneath a bed) the table-non-table became part of people's environments and lives.

5.4. Concluding Remarks

I have described how the interpretations of the table-non-table and framing of the deployments iteratively changed. At the end of this lengthy period of studying the table-non-table, while there were many successes along the way, I progressively aligned the theoretical tools used with the ultimate research goals for the table-non-table inquiring into non-utilitarian aspects of the relationships between humans and technologies. In short, in the last iteration of the study we conducted through RtD a productive framing of the table-non-table as a *postphenomenological inquiry*. By productive I mean that, in my view, I drew on postphenomenology to productively frame this RtD inquiry and to give precision and language for non-utilitarian notions of interaction and uncommon assumptions of human-technology relations. Further, I arrived at a methodological approach in line with RtD and postphenomenology that effectively uncovered key empirical experiences of living with the table-non-table and guided the analysis in ways that yielded new insights into human-technology relations.

As interest in HCI continues to expand into everyday life, concerns move beyond making things that solve problems and make tasks efficient. The table-non-table offers an explorative investigation into this growing design space by inquiring into human-technology-relations *beyond use* through itself. By conceptualizing and carving out particulars across the studies, I made progress in my design research practice, methodologically and theoretically by conceptualizing and carving out particulars across the design artifact, field deployments, and theory.

Figure 15 The first day (left) and last day (right) of study #7.

With postphenomenology, I was able to develop a holistic perspective of the table-non-table; this theoretical framing aided me in understanding how the table-non-table shapes and mediates human experience through moving beyond use and utility. It helped me see beyond the 'rejection' of the participants and embrace it instead. Even when a thing in a home seems useless, it can still shape certain human-technology-world relations, at least in subtle ways. I intuitively knew this was where I wanted to drive the inquiry but there were initial frictions in arriving there. It became clear that *mediations do not speak to us*, as researchers, like ethnographic data does. In the table-non-table case, the early focus on human-centeredness obscured what I aimed to investigate. This is illustrated in Figure 15 where the storing of the table-non-table in the closet at the end of the study was at first seen as a failure, whereas Tom interacting with the artifact at the beginning of the study with enthusiasm (that later waned) was seen as success. However, I came to see this interaction as obscuring the broader human-

technology relations that mediate the world of their apartment. The success of the table-non-table in the closet is that it reveals the subtle mediations and various shared relations that determine the values and desires of not only the different belongings, but their impact on domestic life.

Chapter 6.

Postphenomenological Insights for Design-oriented HCI

In this chapter, I will bring together the collective findings of my investigations, working towards the initially stated overarching goal of exploring how postphenomenology can help complement and expand human-centered approaches to design research and practice with its perspective on human-technology-world relations and related concepts. My attempt towards addressing this overarching goal was twofold; first, by using the two research cases of studying guide dog teams and field deployments of the table-non-table, which both in their own way challenge aspects of human-centeredness; and second and more importantly, through the use of postphenomenology as an analytical lens.

The main research questions I aim to directly answer in my explorative approaches with the guide dog teams study and the table-non-table deployments are:

1) *Can postphenomenology provide the design-oriented HCI community with a valuable holistic view of human-technology relations in complement to human-centered approaches?*

2) *What is revealed about human-technology relations when postphenomenology is utilized within design-oriented HCI research?*

To now specifically address these questions, I will first discuss lessons learned from the two research cases respectively. Second, I articulate considerations for design-oriented HCI through postphenomenology-informed insights that detail novel conceptualizations of human-technology-world relations and related concepts.

6.1. Lessons Learned from the Two Research Cases

As previously stated, both research cases challenged some aspect of human-centered ways of approaching humans and technology within an HCI study. This was a first step in my research journey of exploring to complement human-centeredness. It also supported the second and

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more important step of using postphenomenology as an analytical lens because the framework gave more clarity to my understanding of the opened-up space.

6.1.1. Lessons Learned from the Guide Dog Teams Case

In retrospect, when reflecting back on the original study, several considerable thoughts emerge from the original design research study. In the original study, I had attended to *the connectedness of guide dog teams* that aligns with the postphenomenological concepts of *hybridity* or *co-constituted human subjectivity* and *human-technology relations.* I had also *attended to the impact of guide dogs beyond utility and beyond physical connectedness,* which aligns with the postphenomenological concept of *mediation*.

Because of the encountered strong bond between handlers and their dogs, the original study's focus shifted from looking at visually impaired people using guide dogs to looking at *guide dog teams* (visually impaired handlers and their dogs). This way, the first research case presented an expanded focus centered on a strongly bonded or connected human–non-human *hybrid* rather than solely a human. That means that for HCI, a common epistemological commitment towards human-centeredness was challenged through this case. The (traditionally human-centered) focus of the human was widened to integrate another entity (the dog) and the relation between the human and this entity. Another way of looking at this could be articulated as the human was de-centered[27].

Additionally, the case as I engaged with it in this dissertation, showed how human-centered and postphenomenological study approaches provided different outcomes as they were contrasted. The postphenomenological thinking and doing I performed provided an enhanced understanding and better precision and language to studying guide dog teams. More precisely, postphenomenological concepts allowed for an in-depth view of the entities involved in human-technology-world relations that were studied. The concepts offered a more explicit way of thinking about the handler, the dog as a non-human entity similar to technology, the world as it is to the handler, as well as the different relations between handlers and their dogs. Although in the original study I had attended to the connectedness or 'strong bond' between guide dog handlers and their dogs by looking at guide dog teams rather than handlers, I did not

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[27] A few related works have used the term of 'de-centering the human' in relation to moving beyond human-centeredness in HCI or design research (e.g., DiSalvo & Lukens, 2011; Forlano, 2016; Smith, Bardzell, & Bardzell, 2017)

do this as consciously and informed as I could with postphenomenology. The postphenomenological approach helped me to better understand this analytical shift and also gives it more substantiation; as I was enabled to see the human as co-shaped or mediated by the guide dog. The way I was able to understand and study the human through postphenomenology showed that it was 'a product' of the guide dog's mediation. The guide dog handler's existence is co-shaped by the dog. This offers a new epistemological direction for HCI on viewing the human that is not human-centered.

Furthermore, postphenomenology offered to better understand, study, and describe the mediation of a guide dog (or more generally non-humans). The theoretical framework also allows me to see better that mediations are widely dispersed across use beyond use, utility, functionality as well as happening while being physically connected but importantly also beyond that. This shows clear alternatives to the concept of interaction. I was able to engage with nuanced concepts around the relations between humans and non-humans (or technology) through postphenomenological ways of studying guide dog teams. This offered a productive expansion of the focus on interaction as moving towards relations.

In conclusion, the guide dog teams case provided a productive case example for this exploration of an alternative to the common human-centeredness in the context of HCI. The postphenomenological analysis of guide dog teams provided productive language and precision, as well as an enhanced understanding of the encountered hybridity of human–guide dog teams, different entities at play, and relational aspects involved in *handler–guide dog–world* relations. This offered a novel (non-human-centered) and enhanced way of understanding the human as part of human–non-human relationships and further moved investigations beyond interactions towards a holistic or comprehensive way of understanding relations (rather than interactions).

As a result, this helps to complement a human-centered focus by expanding the view of the human towards integrating relations and mediations, as well as by expanding the understanding of technology as mediating through but also beyond use and physical presence. Moreover, the understanding of guide dog teams' interactions moved towards an understanding of relations and mediations of guide dogs on handlers and the world as it is to the handler.

6.1.2. Lessons Learned from the table-non-table Case

The table-non-table is a research artifact designed to be functional yet not in the service of human use. This way it is in and of itself a material inquiry into non-utilitarian aspects within human-technology relations and clearly challenging a key aspect of human-centeredness in HCI—that is, functionality- and utility-focused assumptions around a technology. As a research case, the table-non-table presented an explorative and speculative way of exploring alternative perspectives to human-centeredness.

Over the course of nearly four years, I conducted iterative field studies, reflections, and conceptualizations that, over time, helped me to make better sense of the table-non-table and the relations that emerged with and through it. I was able to develop precision and language for non-utilitarian notions of interaction (unselfconscious interaction) and engagements of design artifacts (intersections, ensembles).

In the end, I came to see the table-non-table as a *postphenomenological inquiry*. I drew on postphenomenology to productively shape how I theoretically and empirically articulate key qualities of the table-non-table. It allowed me to look past notions of *useful use* to uncover key empirical experiences of living with the table-non-table and see the more subtle and diffuse mediations of the *table-non-table*.

With postphenomenology, I was able to develop a holistic perspective of the table-non-table. The theoretical framing aided me in understanding how the table-non-table shapes and mediates human experience through moving beyond use and utility. Although seemingly designed to be in the background, upon entering a home the table-non-table catalyzes or introduces unknown and uncertain relations that participants try to understand and make sense of. Often that was described as a frustrating process. Over time, the unique nature of the table-non-table emerges through the background to find a place in everyday life. I learned that even if not directly used or seemingly useless, a technology like the table-non-table still shapes the environment (of the home) and lives of people living with it albeit in subtle or weak ways. It co-constitutes a particular reality and human *subjectivity* and *objectivity* of the world.

In summary, the table-non-table in and of itself inquires into non-utilitarian notions around human-technology relations, yet, the postphenomenological way of approaching this inquiry gave precision and language to it. The table-non-table showed that technologies have

mediating effects not based solely on functionality, use or instrumental values but instead through a sole existence; which we can productively analyze and describe. This includes descriptions of mediating effects and how the technology—in this case the table-non-table— organizes the relations of humans in the world or co-constitute subjectivity and objectivity.

6.2. Articulating Postphenomenological Insights for Design-Oriented HCI

In this section, I want to now articulate the developed insights for design-oriented HCI more generally, in order to make this work more applicable. Specifically, this is an attempt to synthesize and illustrate how using postphenomenology as an analytical lens is a productive way to move beyond possible limitations of human-centeredness and complement HCI research. It is my aim to articulate novel postphenomenology-inspired notions or conceptualizations of viewing the 'human', 'technology', and 'technological mediation' within HCI and describe aligning implications and opportunities within the field. These are derived from my research cases and further reflections on their implications. The hope is that these conceptualizations and reflections can be useful to HCI design researcher in future works. Consequently, this will address the main research questions.

6.2.1. The Mediated Human

A postphenomenology-informed conceptualization understands *the human* as a *mediated* and *relational* entity or subject. Technologies or things co-shape human existence including perceptions, experiences, actions and ways of thinking and living. In this view, the human is no longer an entirely autonomous agent with an independent intentionality. The human or human subjectivity can be seen as 'a product' of its relations to technology or technological mediation. This is a novel and non-humanistic view of the human for HCI. Furthermore, the human encounters technology or non-humans through bodily-perceptual relations.

In HCI the *human* is traditionally viewed as a *user* or *experiencer* based on a limited set of perceptions, actions, and values. Clearly, postphenomenology moves beyond this view towards a more complex understanding of the human and more precisely subjectivity. A technologically mediated human subjectivity can be analyzed and described and be

incorporated into the studying and influencing of people's experiences and relations to technology through design.

6.2.2. Technology or Non-Humans as Transformative Mediator

A postphenomenology-informed conceptualization understands *technology* as *transforming mediators*. As a mediating entity, technologies co-shape human subjectivity and the objectivity of the world as it is to the human or in Verbeek's words, "how human beings can be present in the world and how the world can be present for human beings" (Verbeek, 2015, p. 29). More specifically, technologies co-shape human perceptions, actions, experiences, and practices. Abstractly speaking, technologies mediate and organize the relationship between humans and the world.

Traditionally, HCI has been looking at technology considering mostly its functional, utilitarian, or instrumental value and lately its experiential value to human users. Postphenomenology expands this understanding through not only a deeper understanding of the existential and hermeneutic impact of technology on humans which moves beyond solely utilitarian aspects of human-thing relations, but also by putting technology at the center of its inquiry and conceptualizations. This shift clearly breaks with assumptions around human-centeredness in HCI and has a radical influence on technology design. When HCI researchers design technologies, what they are designing "is not [only] a thing but a human-world relation in which practices and experiences take shape" (Verbeek, 2015, p. 28).

6.2.3. The Co-Shaped Objectivity of the World

A postphenomenology-informed conceptualization understands the *world* as a co-shaped entity in human-technology-world relations. Technologies or things co-shape the world as it is and becomes meaningful to the human. The world can be seen as 'a product' of technological mediation.

The world as it is viewed in postphenomenology has been a largely overlooked entity in HCI. Through third wave HCI, technology has been looked at and studied in the everyday context. However, postphenomenology provides a novel understanding of such context and how technology is involved in co-shaping not only humans but also the world as it is to the human.

The co-shaped objectivity of the world as it is and becomes meaningful to the human can be analyzed and described.

6.2.4. Relational Aspects and Mediation

The essence of the previous postphenomenology-informed conceptualizations of the entities human, technology, and world are the *relations* that bring them together. The postphenomenological notion of *relations between humans and technologies* describes human's bodily-perceptual encounters with technology (in their lifeworld). This should be seen in relation to the notion of human-technology-world relations or the idea of technology's mediation of human-world relations. The way humans intersect[28] with or relate to technology and through that experience and perceive the world, and also act in the world, is a result of technological mediation.

Within an HCI context, the postphenomenological notion of technological mediation offers a broader, deeper, and holistic understanding of the human and technology and their relations that moves beyond *interaction* and *functionality*. It also opens up the opportunity for approaching design interventions in a mediation-centered way rather than a solely human-centered way. Investigating mediations allows HCI design researchers to holistically inquire into the roles of technology in people's lives. Another important aspect that the notion of mediation offers is being able to look beyond human-centeredness. While within postphenomenology, artifacts are indeed seen for their mediations rather than their mere instrumental or functional purposes, the studied technologies can also have clear functionalities with at times close-ended purposes.

At this point, the earlier (see Figure 1 in Chapter 2) presented figure illustrating these principles is shown again below (see Figure 16) as it can now be viewed again in a more advanced way and in the context of the postphenomenology-informed conceptualizations for HCI.

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[28] Note, here postphenomenological literature often talks about interacting, yet I wanted to stay away from this term as in the context of this dissertation it could be confused with the HCI-oriented understanding of interacting and interaction.
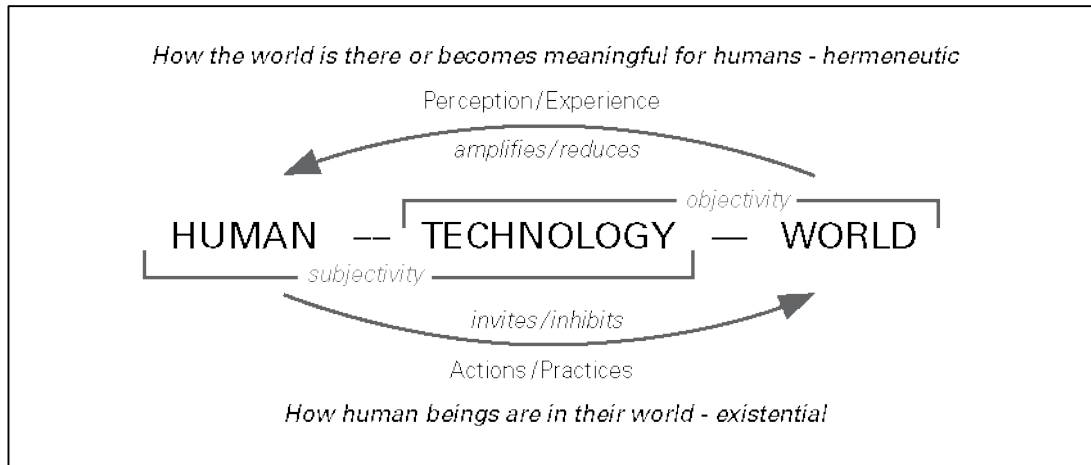
Figure 16 Illustration of Technological mediation (based on Verbeek's (2005) descriptions).

Returning to the research questions, thus far this work shows an alternative or complementary approach to human-centeredness in HCI by illustrating a focus moving beyond solely the human (or decentering the human), a view beyond an instrumental view of technology towards a mediating view, and beyond the notion of interaction towards the notion of relations. A postphenomenological view brings to HCI a shift of foci and re-conceptualizations of the human and technology, as well as the relations between humans and technology. Humans and technology are not seen as two separate poles between which there are interactions, rather they are the result of the interaction or better relation. The human and technology in fact mutually shape each other in the relations that come about between them.

What is revealed in *design-oriented HCI through postphenomenology*, as demonstrated in this dissertation, is a holistic perspective on the matters of concern to the field of HCI that can be complementary to previous ways of understanding. This is illustrated through the description of novel postphenomenology-inspired conceptualizations of viewing the 'human', 'technology', 'world', and 'technological mediation' within HCI and aligning implications and opportunities within the field.

Postphenomenology opens up a view of the human that in one way *decenters* the human and puts technology and the mediating effect of technology at the center (see Figure 16). In this, the human however is still a central concern. It is understood as technologically mediated. The subjectivity and intentionality of the human is co-shaped through the relations organized by technology. The way humans act in the world and understand the world is mediated by technologies, which HCI researchers are inquiring into. This perspective

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overcomes a narrow view of the human present in human-centered approaches and it can help HCI researchers get a holistic view of the human taking into account the relations that in fact 'make' the human.

6.3. Reflecting in and on my Design Research Practice

Throughout the prior three chapters, I have offered accounts of my reflexive practice of design research. In this, I have attended to the iterative processes of incorporating postphenomenological ways of thinking and doing into my practice. This work enriches the HCI community's understanding of the nature and value of design practice as a form of inquiry. Additionally, it has potential to help unsettle and debate the complex relationship and interplay among theory, things, and humans.

6.3.1. Things and Theory

With the table-non-table case, I contribute a rare account of insights into how my research practice was informed through oscillations between the making of a design artifact which was informed by theory, as well as how theory also informed my ways of studying it through field deployments. An evolving theoretical backdrop in dialogue with ongoing field deployments enabled me to better grapple with and make sense of the table-non-table as a research inquiry. Crucially, it was through this process that theory ultimately enabled me to understand and articulate key qualities of the table-non-table and to better align the aims of the theory with the aims of my design practice. Gaver (2012) argues that theory underspecifies the artifact—there is a maturity to real, actual things in the world that theory cannot fully articulate or account for. In the table-non-table research case, I concretely demonstrate this point. The theory never over-determined my work. In early deployment studies, the norms of the theory were not quite aligned with what I sought to do in the practice, and this produced frictions. It led me to believe I had a theory that contained the norms that I desired, but later it became clear that initially I had not applied theory in practice sufficiently. In the final stage of my RtD inquiry, I found that the theoretical framing and design artifact came into alignment; it enabled me to articulate and understand the particular quality and nature of the table-non-table more clearly. I did not need to 'redesign' the table-non-table to figure out a way it could better 'fit' with theory. Rather, my

theoretical framing helped me surface, articulate, and critically reflect on the table-non-table and better understand it.

In the case of guide dog teams, my use of theory shifted and helped reframe how I approached looking at things, in particular the guide dog. As soon as I arrived at the idea of conceptualizing the dog as a non-human or thing, it became interesting for further explorations with a shifted set of assumptions. The thing did not have to be 'designed' anymore as traditionally assumed. Through the shifted theoretical assumption of 'a thing' being 'designed', I was able to rethink how postphenomenology could be applied to my research case. In this situation, the key empirical relation between theory and humans was opened up towards a relation between theory, things, and humans.

This brief reflection makes clear that there is a need for future works to account for and unpack how theory relationally shapes and is informed by the practices of design research through the making and studying of design artifacts. Furthermore, as design researchers we need to acknowledge and respect the notion that the things we make often exceed the articulations and normative assumptions of theory.

6.3.2. Empirical Approaches for RtD

In neither of my cases I want to claim that I have found ideal ways of studying while incorporating postphenomenological ways of thinking into my empirical practice efforts. I see my work as offering attempts and pointing towards the need for future work on methodological challenges and advancements around postphenomenology-informed ways of approaching in the context of design-oriented HCI.

For instance, in the investigations with the table-non-table, I wrestled with my empirical approaches. I do not claim that I have found the 'ideal' way of studying and uncovering postphenomenology-informed ways of conceptualizing this artifact or research artifacts more generally. Rather, I aim to stress the importance of deployments for providing empirical data for actual realities with research artifacts and the need to look at mediations. Postphenomenology is an empirically-oriented philosophy and derives its insights from actual experiences with technologies (Rosenberger & Verbeek, 2015a). Nevertheless, the main focus is on mediations giving a more active role to things that co-constitute reality. Deployments reveal important accounts of living with the table-non-table (i.e., different accounts of human-technology relations

and mediations). However, I had to overcome the ethnographic account that centered on participants' voices. Although experiential accounts are needed, I had to move my attention to mediations ascribing a more active role to an artifact. For example, in the second study series I focused on how the artifact could fit in a home, but through a postphenomenological approach, the artifact became the starting point and is seen as co-constituting (i.e., 'changing') the home. I see the need for more inquiries into the methodological commitments of RtD deployments dealing with the complex nature of human-technology relations in everyday life. Similarly, I do not want to claim I can now prescribe the best way of how to better study guide dog users or other groups of people in the field with postphenomenology in mind.

6.4. Concluding Remarks

In this chapter I came full circle on my research endeavour. I described lessons learned from my two research cases and discussed findings towards addressing my main research questions.

Chapter 7.

Vertical Grounding of Research Findings and Further Discussion

Thus far, this doctoral work has demonstrated that the postphenomenological framework can operate as a productive lens to understand and analyze human-technology relations in design-oriented HCI research. Particularly, in the second research case I show how postphenomenology can operate both as a generative lens to frame the crafting of design research artifacts and as a framework to analyze empirical studies of them. Accordingly, postphenomenology brings powerful analytical concepts to HCI and Research through Design (RtD). This can directly aid HCI researchers, deepening and broadening their understanding of human-technology relations, and offer a more nuanced view of the mediating effects of technology in everyday life.

In this chapter, my goal is to offer an extension and generalization of this part of my work and reflect further on the implications of the answers to my research questions. I approach this endeavour by extending the idea of seeing the table-non-table as a *postphenomenological inquiry* onto several other research artifact inquiries through the creation of an annotated portfolio. This part of the dissertation can also be seen as a *vertical grounding* of research findings and a step towards turning the findings of postphenomenology operating as a generative lens to frame the crafting and studying of design research artifacts into a *strong concept* (Höök & Löwgren, 2012).

Furthermore, later in this chapter, I offer a critical reflection on some of the limitations of postphenomenology informing design-oriented HCI, and lastly, I discuss insights on how from a postphenomenological point of view, the main two research cases in my dissertation present different ways of challenging and extending elements of the field of postphenomenology.

7.1. An Annotated Portfolio on Doing Postphenomenology through Research Products[29]

At the end of Chapter 5 I came to see the table-non-table as a successful *postphenomenological inquiry*. I drew on postphenomenology to productively frame the table-non-table as an inquiry that investigates beyond utilitarian and common assumptions of human-technology relations. In this section, I want to explore if this conceptualization can apply to other RtD artifact inquiries as well I do this by analyzing a number of RtD artifact inquiries with conceptual postphenomenological framings through the creation of an annotated portfolio and subsequent reflection. Annotated portfolios (Bowers, 2012; B. Gaver & Bowers, 2012) is an emerging method in design-oriented HCI research that, in this case, helps bring together a collection of key RtD artifacts exploring human-technology relations to show how they align with postphenomenological commitments.

In what follows, I detail my methodological and analytical approach and highlight my commitments to RtD and postphenomenology. I then explore postphenomenological commitments in design research artifacts alongside three themes through an annotated portfolio. Lastly, I reflect on what this approach holds for future work in the HCI community.

7.1.1. Investigations of the table-non-table and Tilting Bowl

I came to see the table-non-table as a successful postphenomenological inquiry (see Chapter 5). I drew on postphenomenology to productively shape the capacity to theoretically and empirically articulate key qualities of the table-non-table. This allowed me to look past useful use to uncover key empirical experiences of living with the table-non-table and see the more subtle and diffuse mediations of the table-non-table. The utilization of postphenomenology in my studying and conceptualizing of the table-non-table enabled me to frame this RtD inquiry to develop precision and language for non-utilitarian notions of interaction and uncommon assumptions of human-technology relations.

In a concurrent research project, my colleagues and I designed and studied the *Tilting Bowl* (Wakkary, Oogjes, et al., 2018) which is a ceramic double-walled bowl with a hidden motor that lets the bowl tilt occasionally (see Figure 17). It is similar to any other ceramic bowl in that it

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[29] This chapter is largely based on material that is adapted from (Hauser, Oogjes, Wakkary, & Verbeek, 2018)

is food safe and washable. The Tilting Bowl is counterfactual in that it looks and functions like a regular bowl except that counter to what is common to bowls, it tilts. By defamiliarizing such a familiar artifact through digital technologies, the Tilting Bowl specifically inquiries into the types and qualities of relationships beyond use and functionality that may emerge. Previously articulated non-utilitarian notions of interaction, such as *intersections* and *ensembles* (Odom & Wakkary, 2015; Wakkary, Desjardins, et al., 2015), were generatively worked with to guide the design of the Tilting Bowl. Six bowls have been deployed in the households of philosophers to inquire into postphenomenological topics and questions. From this study, novel and rich descriptions have been emerging with respect to alterity and background relations with the Tilting Bowl in particular.

Figure 17 Tilting Bowl filled with fruit on a household table.

Together, the investigations of table-non-table and Tilting Bowl offer empirical and reflexive accounts of human-technology relations and technological mediations with counterfactual RtD artifacts. Both contribute argumentative exemplars for the value and use of postphenomenological concepts and concerns for considering RtD artifacts in HCI. This helped me see the productive postphenomenological framing of RtD-inquiries and made me aware of the similar interest between postphenomenology and RtD artifact inquiries; and further it motivated me to explore whether other RtD projects could similarly be seen as postphenomenological inquiries.

7.1.2. Methodological Approach

The productive postphenomenological framing of RtD-inquiries and the similar interest between postphenomenology and RtD artifact inquiries can potentially be viewed or turned into a *strong concept* in and for future interaction design research. The step in this part of the dissertation then can be seen as substantiating the postphenomenological framing as a strong concept through *vertical grounding*. Höök and Löwgren (2012) describe strong concepts as "a particular form of generative intermediate-level knowledge" (p.23:3). Specifically, referring to the generalization of qualities or aspects about artifacts they state: "Elements of that particular artifact, or instance, can be isolated and abstracted to the level that they are applicable in a whole class of applications, a whole range of use situations, or a whole genre of designs" (Höök and Löwgren, 2012, p.23:5). Strong concepts rely on a horizontal and a vertical grounding. The research endeavor in this part of the dissertation can be seen as a vertical grounding of earlier research findings. Thereby it may offer a step into the generation of a strong concept. Vertical grounding for example means to inquire into whether a strong concept is "present in other known instances" and into whether "those other instances [can be used] as a broadened empirical base upon which to learn more indirectly about the strong concept" (Höök and Löwgren, 2012, p.23:15).

In developing an annotated portfolio of RtD artifact inquiries, I aim to bring out particularities of enacted postphenomenological dimensions across a range of RtD projects. For this a number of projects were selected according to developed selection criteria. A first selection criterion was that the RtD artifact inquiries were in line with two methodological commitments to RtD pursued in the crafting and studying of table-non-table and Tilting Bowl: *Material Speculation* and *Research Products*.

In *material speculations*[30] (Wakkary, Odom, et al., 2015), artifacts are designed to be lived with over long periods and are crafted to embody research questions or propositions through what are called *counterfactual artifacts*. A counterfactual artifact is a fully realized functioning product or system that intentionally contradicts what would normally be considered logical to create given the norms of design and design products. This countering of norms, opens the possibilities to empirically investigate multiple alternative existences (or what-ifs) as

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[30] Although this was explained in section 5.1.2, for better reading flow material speculation is explained again.

lived-with realities of the counterfactual artifacts. In addition to counterfactuality, material speculations rely on crafted research products to perform the inquiry.

Odom et al. (2016) describe *research products* through four qualities of *inquiry driven, finish, fit,* and *independent*. The artifacts are designed to drive a research inquiry; they have a high quality of finish such that people engage with them as they are, rather than what they might become and such that they can fit among other things and into everyday environments; and lastly, they operate independently in everyday settings over time. The term and concept of research products "emphasizes the actuality of the design artifact helping to overcome the limitations of prototypes when investigating complex matters of human-technology relations over time, which is of growing interest in the HCI community" (Odom et al., 2016, p. 2550).

My selection process began by first collecting RtD artifacts without specific curation criteria. I searched for published articles, images and videos of them and ended up with over thirty artifacts. I then determined which held up against the criteria of research products and material speculation. I made sure that there were published articles or videos of them reporting on real-world placements or experiences with the artifacts (e.g., participant deployments or auto-ethno-graphic self-deployments). I also wanted the chosen RtD projects to be from various sources, including different design research studios ("Everyday Design Studio, School of Interactive Arts & Technology at Simon Fraser University," n.d.; "Interaction Research Studio, Goldsmiths, University of London," n.d.) and design researchers (e.g., Mackey, Wakkary, Wensveen, Tomico, & Hengeveld, 2017; Pierce & Paulos, 2015b).

The Selected Research Products

Next, I offer brief descriptions of my final choices of RtD inquiries and refer to publications that report on each project in more detail.

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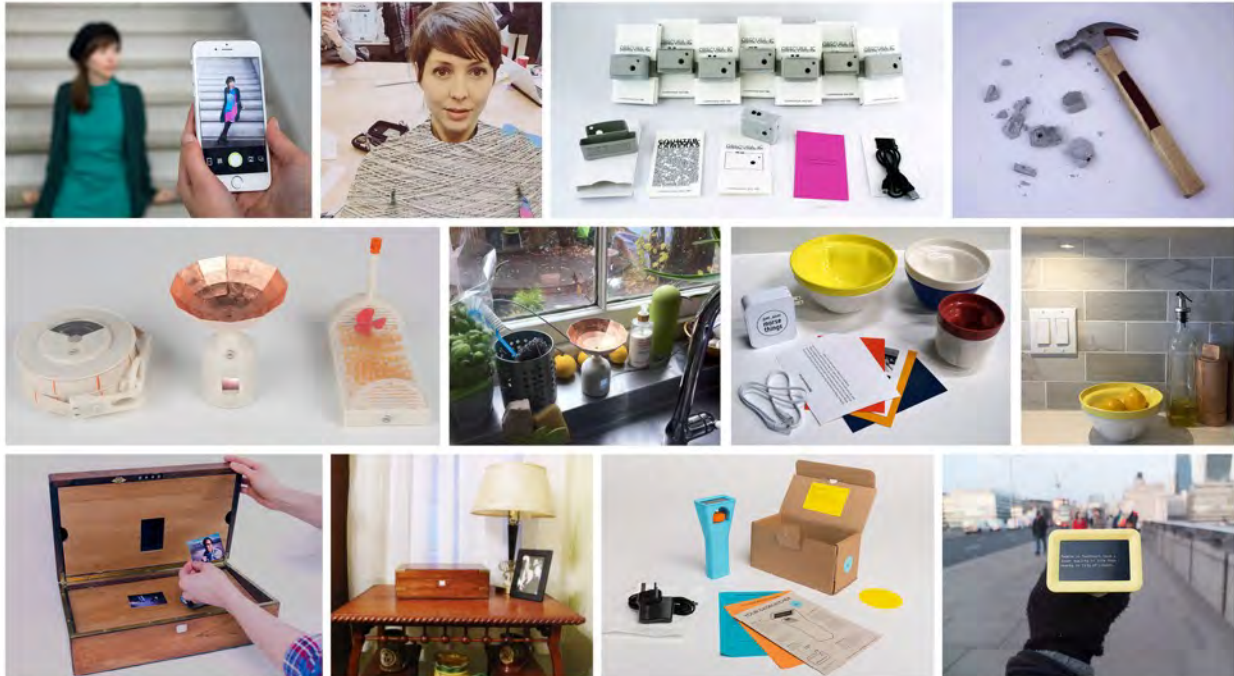
Figure 18 The Selected Research Products. Top, Middle, & Bottom (L to R): T1&2. Greenscreen Dress; T2&3. Obscura 1C Digital Camera; M1&2. Indoor Weather Stations; M3&4. Morse Things; B1&2. Photobox. B3&4. Datacatcher. Image credits: T1&2 © Angella Mackey, T3&4 © James Pierce; M1&2, B3&4 © Interaction Research Studio; M3&4 © Everyday Design Studio; M3&4; B1&2 © William Odom.

Greenscreen dress (Figure 18, T1&2) is a long-term investigation into the wearing of dynamic textiles (Mackey, Wakkary, Wensveen, & Tomico, 2017; Mackey, Wakkary, Wensveen, Tomico, et al., 2017). With the use of a chroma key mobile application, content is digitally displayed on green fabric. The design researcher, Mackey started with wearing a green dress and expanded this to other green garments she bought or made. Mackey et al. report on her day-to-day experiences of wearing green dynamic clothing for ten months.

Obscura 1C Digital Camera (Figure 18, T3&4) is a camera with a concrete housing that would have to be destroyed in order to view the pictures (Pierce & Paulos, 2014, 2015b, 2015a). The designer-researchers Pierce and Paulos have reported on Pierce's own experiences of using the *Obscura 1C*. They produced around 20 cameras of which 10 were distributed purposefully through Craigslist ads, bulletin boards and local stores. They did not follow up on the deployment of these design artifacts.

Indoor Weather Stations (Figure 18, M1&2) is a set of three objects aimed at playfully exploring environmental awareness of the home (Cameron, Jarvis, & Boucher, 2014; Gaver et

al., 2013; Jarvis, Cameron, & Boucher, 2012). The *Wind Tunnel* measures gusts of air near the device and visualizes these through a small fan that creates storms through paper film trees. *Temperature Tape* resembles a measuring tape but visualizes different temperatures within the home through screen-printed stripes that change color from yellow, orange, red and black corresponding with temperature. The *Light Collector* measures and recreates the color of the ambient light in the home. Over 20 sets were batch-produced and deployed to more than 20 households over the course of a year.

Morse Things (Figure 18, M3&4) are sets of connected cups and bowls that communicate solely to each other in Morse Code and over Twitter (Wakkary et al., 2017). They were deployed for six weeks with designers and design researchers with an interest in the IoT.

Photobox (Figure 18, B1&2) is an antique chest that prints four or five randomly selected photos from its owner's Flickr collection at random intervals each month (Odom et al., 2012; Odom et al., 2014). Three *Photoboxes* were created and then deployed in three households for 14 months respectively.

Datacatchers (Figure 18, B3&4) are mobile devices that collect and display topical information about their surroundings (e.g., house prices, typical incomes, etc.) (Boucher, 2016; Boucher & Gaver, 2017; Gaver et al., 2016). Scrolling the wheel one way will display messages and turning the other way accesses a poll. 100 *Datacatchers* were deployed for two months. Two filmmaking teams collected over two hours of footage of the participant's lived experiences of the devices in context.

Creating the Annotated Portfolio

Annotated portfolios are "a means for capturing the family resemblances that exist in a collection of artifacts, simultaneously respecting the particularity of specific designs and engaging with broader concerns" (Bowers, 2012). In the context of my work, the utilization of annotated portfolios provides me with a concrete way of showing conceptual themes I viewed as generalizable to other designs (based on prior work). As Bowers describes further, "Annotated portfolios are *descriptive* (of past occurrences) and intended to be *generative-inspirational* (of future possibility) with their primary business constituting a portfolio in close contact to […] the actual artifacts themselves" (Bowers, 2012, p. 76). Annotated portfolios allow for a way to explore what postphenomenology holds for design researchers by not simply giving prescriptions.

Alongside concept-driven interaction research (Stolterman & Wiberg, 2010) and strong concepts (Höök & Löwgren, 2012), annotated portfolios (Bowers, 2012) offer a method for theorizing in interaction design research. These approaches are related in their goal of supporting the development of design knowledge that lies between theories and instances. Höök and Löwgren (2012) explicitly characterize this as *intermediate-level knowledge*. Bowers (2012) and Löwgren (2013) define annotated portfolios as offering intermediate-level knowledge for design research. My work extends these approaches by providing an interpretive account of methodological commitments through annotations of RtD artifact inquiries.

Annotation Themes of Postphenomenological Commitments

For my annotation process, I developed three themes based on descriptions of how postphenomenological studies methodologically operate (Rosenberger & Verbeek, 2015a)[31]:

1) Empirical work as the basis of the inquiry

2) Structures of human-technology-world relations as a starting point

3) Technology co-constitutes objectivity and subjectivity of any given situation (mediations or implications)

I analyzed how the selected research products express these commitments by going through their respective published works and annotating them in a lengthy process. From this, I developed the final annotated portfolio of postphenomenological research products. The annotated portfolio consists of detailed descriptions of the three themes followed by a description of how the selected research products represent them. The following three research questions are guiding in this endeavor:

- *What kind of empirical work is done with and through the selected research products?*

- *What structures of relationships are at play across the selected research products?*

- *What are mediations of the selected research products in people's lives? What kind of 'world' (objectivity) and what kind of 'human' (subjectivity) is co-constituted by them?*

The following annotated portfolio through its descriptions answers these questions for all the chosen six research products.

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[31] Please refer to Chapter 2, section 2.2 for a more thorough description of the postphenomenological commitments and key examples.

7.1.3. An Annotated Portfolio of Postphenomenological Commitments in Research Products

In the following annotated portfolio, I describe how the selected research products express each of the three annotation themes.

Empiricism in Research Products

The *Greenscreen Dress* (Mackey, Wakkary, Wensveen, & Tomico, 2017) was studied for seven months as an autobiographical design and auto-ethnographic study. The first author incorporated green clothing in her outfits daily during this time and took pictures and videos that she shared on social media. The actuality of wearing the dynamic fabric daily allowed the authors to reflect on real-life implications of such a technology, e.g., the possibilities and limitations in expressing personal style.

Approximately 20 *Obscura 1C Digital Camera'*s (Pierce & Paulos, 2015a) were created, including packaging and instructional material that allowed the camera to be stand-alone: they can be understood and used without scaffolding or interference of a research team. As such, the empirical account builds on the specific actuality of this counterfactual and counterfunctional artifact. In addition, 10 packages were distributed through approaches such as bulletin boards, local stores, and Craigslist ads. Pierce (Pierce, 2014) also reflects on his own experience with the *Obscura 1C.*

The *Indoor Weather Stations* (Gaver et al., 2013b) were also batch-produced and deployed in 20 homes. The researchers recruited participants who lived near the research studio through posters in the area and websites of local interest. Participants first participated in a cultural probe study to encourage reflection on their indoor climate (Cameron et al., 2014). After this, the packaged *Indoor Weather Stations* were given to participants either at group events, at the research studio or during individual drop-offs. Data collection included home visits and prompts. During the study, the researchers created a web platform for visualizing the data of the *Indoor Weather Stations* of participating households to enable further engagement between participants and the devices.

Participants for the *Morse Things* (Wakkary et al., 2017) were recruited through personal contacts of the research team. The team was looking specifically for trained designers and researchers with an expertise in the area of connected things. The participants received a box

containing a manual, instructions for deployment, a router and three *Morse Things* (one red, one yellow, one blue). Participants were asked to describe what it is like to live with the *Morse Things* from the perspective of the things and to create design proposals for things that could co-exist with the *Morse Things*. After living with the artifacts for six weeks, self-reporting on the experiences, and sharing and discussing the experiences and design proposals in a workshop, the participants and researchers were able to speculate on new types of connected things in the home.

The *Datacatchers* (Gaver et al., 2016) were batch-produced and deployed to around 100 participants. The researchers were specifically interested in semi-random approaches to the deployment to be able to get responses from a broad demographic. They commissioned a service consultancy to form a deployment team, which recruited participants at local markets. Once participants agreed to be part of the study, a package containing a manual, a charger and a Datacatcher was given to the participants on the spot. The participants lived with the devices for two months, after which filmmakers (briefed by the research team) made a short documentary (1-5 minutes) of each participants' experience with the devices.

With the aim of exploring topics such as anticipation, reflections and re-visitation, *Photobox* was part of a long-term deployment in which three nearly identical photoboxes were deployed in three households for fourteen months respectively (W. T. Odom et al., 2014). The participants were recruited with the requirement of having a large Flickr account. *Photobox* was described to participants only briefly to allow for them to create their own interpretations over time. To collect these temporal accounts, home visits and interviews were conducted bi-monthly. This longitudinal study allowed the researchers to reflect on the mediations *Photobox* brought forward with the Flickr archive and on how the artifact took on different roles over time.

Concluding Remarks about Empiricism in Research Products

The RtD artifacts that I discussed are bespoke to the inquiry and counterfactual in nature. Studies of them rely on the actual existence of the artifacts and the fact that they can be taken as is. Through these combined commitments it becomes possible to study not merely a new artifact, but also the newly constituted world in which this artifact exists. The presented studies enable the researchers to inquire into the lived experiences of this new world. These experiences can form the basis of uncovering mediations and relativistic accounts. I will elaborate on how this is the case across the selected RtD works in the forthcoming sections.

Relationship Structures in Research Products

Greenscreen Dress can be seen as becoming part of a fusion relationship. Mackey et al. describe how Mackey responded to the merging of the green garment and her body from her first-person perspective: "*I observed that being completely covered in the green fabric from my neck to my knees was too strong in that I felt overpowered by the complete digital transformation of most of my body. Some days I only wanted a pocket or collar that was green, a green-striped print or just green pants*" (Mackey, Wakkary, Wensveen, & Tomico, 2017, p. 55). While physically arguably less intrusive than brain implants, the fusion of the green garments was obvious and even overwhelming to Mackey. Her reflections on responses of the select group of people who were aware of the study illustrate further the intimate relation with and through the garments that goes beyond embodiment: *"Only colleagues, friends and family members intimately aware of this study recognized the greens I wore as 'active' and were able to experience the live, AR [augmented reality] versions of the clothing through my smartphone. Mostly, this awareness provoked a heightened attention to what I wore each day and sometimes a question like 'Oh, you're not wearing green today?' would bring attention to this. I would respond by pointing to the subtle green leaves within the pattern of my shirt, or the green hue in my 'blue' pant"* (Mackey, Wakkary, Wensveen, & Tomico, 2017, p. 57)*.*

The *Obscura 1C Digital Camera* is mainly part of a background relationship. With the use being limited towards not being able to access or experience the images taken with the camera, the 1C has an absent presence in the life of its user.

The *Indoor Weather Stations* were designed to be part of a hermeneutic relation. Gaver et al. describe that they "*reveal the home's microclimate by highlighting small gusts of wind, the colour of ambient light, and temperature differentials within the home*" (Gaver et al., 2013, p. 3451). More specifically, *"[t]he temperature measure […] tells you something about your energy use. In my room I was quite shocked at the temperature difference from one end of the room to the other, how cold it was in the middle of the room with the central heating on"* (Cameron et al., 2014, p. 7). Similar to the the *Photobox*, there was a time period in which participants had to get adjusted to the new (and different) design artifacts in their lives. A participant described that the constant whirring of one of the weather stations changed from being irritating to soothing, something he only noticed in its absence (Gaver et al., 2013). Another participant made the remark that she loved things that *"haven't quite settled down yet into what they are going to be"* (Gaver et al., 2013, p. 3455).

In another remark Gaver et al. (Gaver et al., 2013, p. 3455) describe that they thought their design artifacts were failing because their participants were not engaging with them. However, they realized that there was an attachment that had developed while the devices had found a place in the background: "*Moreover, even though it was not uncommon for participants to tell us that they no longer engaged with the devices after a month or two, they were still adamant that they did not want to return them, but preferred for the devices to stay in their homes. They had become part of the home's 'background' and in a desirable way*" (Gaver et al., 2013, p. 3458).

Morse Things operate mainly in the background but also have alterity aspects to them. For example, participants thought of them as having human qualities and as being like pet cats: present and interactive but not always interested in humans. One participant "*thought the Morse Things would be happy with their new home, and as [they] made sounds when she and Noah entered the house, she imagined them to be happy to see them: 'they were here and they spoke a little bit and then we went out for dinner […] we came back […] and as we entered the door, someone, one of them was like bipbipbip, and I was like, Oh! He's so happy to see us!*" (Wakkary et al., 2017, p. 508).

Photobox can be seen as dominantly in a background relation; (indeed, Odom et al. describe the *Photobox* as a "background device"). For example, consider the following quotes from Odom et al.'s participants in which they reflect on living with *Photobox*: "*[It's] in the backdrop of our life, not distracting, just there. [..] .like many of the things we keep out on the mantle or put up on the wall*" (Odom et al., 2014, p. 1968). Another participant described the fading into and out of the background: "*it's awesome to find new photos, but [Photobox] doesn't make me crazy to run over and check it every time I get home. […] I can walk past it. I can come back later. […] in that way it has quite a different character*" (Odom et al., 2014, p. 1968). Importantly, there was a period of time participants needed to get used to the *Photobox* in their life and as it is. Odom et al. describe this in their study: "*Despite the relative simplicity of the Photobox, it provoked a range of reactions across households—many of which were characterized by initial frustration and disappointment, which slowly shifted towards acceptance, and pleasurable anticipation*" (Odom et al., 2014, p. 1965). After several months of living with it, a participant described the technology as "*one that could be closed up and fade away, not demanding nor requiring the owners' attention*" (Odom et al., 2014, p. 1965).. Lastly, human-

technology relations with *Photobox* are somewhat uncommon in that users cannot control how often or when it is printing photos can be seen as entailing alterity aspects.

Lastly, *Datacatchers* give access to an aspect of the world by providing a representation of information about the near environment which users then interpret. This represents a hermeneutic relation. Additionally, users can move around with the device in hand and see added aspects of their environment through the devices through an additional layer of information. This can be seen as combining an embodiment, hermeneutic and even augmentation relation.

Concluding Remarks about Relationship Structures in Research Products

Collectively, through my annotations I described the structures of human-technology relations across the selected research products. I have shown that artifacts can become part of several relationship structures and can further entail subtle relational aspects. Importantly, the novelty in research products commonly results in relationships and their dynamics to evolve over time. This way, research products may, unlike the commonly studied things in post-phenomenology, cause a low sedimentation or transparency in relationships. Additionally, research products can also challenge common postphenomenological understandings of human-technology relations.

While it is true that any technology can be analyzed for its relational aspects, I believe that such analyses for RtD artifacts specifically hold promise for HCI. Postphenomenological structures can bring new insights into future RtD analyses. Traditionally, in HCI there is a focus on alterity relations. The presented nuanced structures give ways to the more complex and meaningful relations coming about between humans, technologies, and the world.

Mediations of Research Products

In the Greenscreen Dress study, Mackey et al. report on how Mackey's perception of and experiences with the system moved from being "gimmicky" to an exploration into regaining control and expressing identity. In her study, the color green is constituted as something with virtual potential. Through this, and through her commitment to wearing a dynamic fabric every day, Mackey built her wardrobe with green as a central consideration: "The resulting wardrobe was a product of rebuilding my personal identity through clothing that confronted the constraint of green fabric and allowed for the chroma-keying action to happen" (Mackey, Wakkary, Wensveen, & Tomico, 2017, p. 55). This process allowed her and her co-authors to further understand the

nuances of green fabrics in combination with the interaction possibilities of the mobile application: "She used the sensitivity slider in the application interface to render fabrics less "effective" to the keying-out, so that shadows and textures could remain. She found that dark greens and pastel greens gave a "grainy" effect to the digital content. She found that sheer materials worked in surprising ways whereby they could hold a faint layer of the digital content while still remaining transparent" (Mackey, Wakkary, Wensveen, Tomico, et al., 2017, p. 449).

Mackey et al. (Mackey, Wakkary, Wensveen, & Tomico, 2017; Mackey, Wakkary, Wensveen, Tomico, et al., 2017) further report on how most of the digital content Mackey 'wore' came from captures from her surroundings. They describe how she collected and stored these images and videos as 'things to wear'. They elaborate on how she started thinking of these as patterns, similar to how one would think of patterned fabric. As such, her environment was constituted as wearable through the system of Greenscreen Dress.

Pierce shares his own account of living with an Obscura 1C describing a co-constituted subjectivity of himself: "In my own use of the Obscura 1C, I have occasionally sat and held the camera while I vaguely imagined what might be inside. I also have distinct memories of images I believe I captured but that I know I may never actually see. In several instances, I consciously chose not to capture a corresponding image with a conventional camera (Pierce, 2014, p. 126). When sharing a post on Craigslist to offer the Obscura 1C as a form of distribution (Pierce & Paulos, 2015b), Pierce and Paulos also created a reality or world (objectivity) with the Obscura 1C existing in other people's lives. In the post, they asked people to motivate why they wanted to own an Obscura 1C and how they envisioned using it. The received responses further support the legibility of the world created through the artifact.

The Indoor Weather Stations emphasize that the home can be seen as a microclimate, changing the perception of this environment. One participant shared: "My lightbulb moment was when I thought about the house as being an ecology—that it's not a sealed homogeneous box" (Cameron et al., 2014, p. 7). In terms of implications around the subjectivity of their participants, Gaver et al. also share unexpected implications: "While the stations only marginally aroused the kind of investigative curiosity of the microclimate of the home we had expected, we found participants using them to make sense of their homes in other ways—particularly when they could see their own data over more extended time periods than the device's replay buttons allowed" (Gaver et al., 2013, p. 3455).

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Participants in the *Morse Things* study experienced tensions with making sense of the non-human-centeredness of the artifacts. Their perspectives of the cups and bowls shifted back and forth between anthropomorphized and withdrawn: "While Olivia 'loved imagining' that the Morse Things talked and cared for her and her partner, she realized that 'that's not what they're saying at all, and they don't care about us at all'" (Wakkary et al., 2017, p. 510). Another participant described how he did not perceive the Morse Things as different from other cups and bowls, yet mentioned that it may take more time to understand them and considered learning Morse Code to follow their conversations. Although the Morse Things were used in households, among other bowls and cups, to hold food, liquids and trinkets, they garnered special attention. One participant reported: "I continue to keep trying to grab the bowls while they are "tweeting." I don't know why I'm doing this, because I can just wait and check Twitter to see which bowl it was … guess I feel like I might be able to learn if they have different sounds? Maybe I'll be able to tell them apart eventually" (Wakkary et al., 2017, p. 509). Further, in their proposed design concepts, the things supposedly co-existing with the Morse Things were often more human-centered and connecting with human practices. Through both study engagements, participants were trying to find new ways to constitute the relationship between them and the Morse Things.

Odom et al. share many insights about the mediating or co-constitutional dimensions of Photobox: "While households were initially frustrated by the slow rate of photos being printed, over time they appreciated how this pace created time to reflect on an individual image and the memories it triggers […] participants described how, over time, the relative slowness of our prototype provoked them to consider the rate at which other domestic technologies operate" (Odom et al., 2014, p. 1966). Further, Photobox "provoked some participants to critically consider the role of technology in their everyday lives" (Odom et al., 2014, p. 1968) as one of their participants took a break from Facebook.

Odom et al. specifically speak to the changes in the experiences and perceptions across Photobox owners, describing "how [their] participants' perceptions of the Photobox changed over time as it transitioned from a perplexing and, at times frustrating, device, to one that was eventually understood and integrated into the home" and thereafter "how, over time, the Photobox supported experiences of anticipation, reflection, and meaningful interactions with participants' Flickr archives" (Odom et al., 2014, p. 1967).The Datacatchers short statements reveal information about the surrounding area appearing every few seconds. The statements are on topics like average housing prices, typical incomes, and the number of pubs or GP

surgeries nearby (Gaver et al., 2016, p. 1598). Gaver et al. write that the statements "simultaneously draw attention to the sociopolitical topology of the lived environment and to the nature of big data itself (Gaver et al., 2016, p. 1597). The Datacatchers were seen by many of Gaver et al.'s participants as "extending the environment, however, by adding 'a new layer to the city with the data and information that you can't really see when you walk around'"(Gaver et al., 2016, p. 1603). This had an effect on their user perceptions of the environment. For example, one participant of Gaver et al. shared: "I think the thing that really shocked me first was what a depressing area I live in, because all the statistics are about crime and health and how unhealthy the people are in my neighbourhood and in my community. You know that immediately starts you thinking: 'Is this the place that I live in'" (Gaver et al., 2016, p. 1604).

Concluding Remarks about Mediations of Research Products

Through my annotations I described how the selected research products mediate people's lives and worlds, for instance by shaping new subjectivities and objectivities. Investigating these mediations allows researchers to holistically inquire into the role of technology in people's lives. Another important aspect that the notion of mediation offers is being able to look beyond human-centeredness. While within postphenomenology, artifacts are indeed seen for their mediations rather than their mere instrumental or functional purposes, the studied technologies do also have clear functionalities with at times close-ended purposes. This further highlights the potential I see for RtD approaches to engage in philosophical work. Where postphenomenological studies report on the role and implications of functional technologies in people's life, for instance mediations of existing ultrasound technology, RtD artifacts are often more open-ended and therefore able to forecast with detailed descriptive accounts. Importantly, this entails how research products shift not only existing relations to digital technologies but may even challenge them and shape *new mediations* given their novelty (e.g., new ways of experiencing archived photos with *Photobox*, new ways of relating to clothing through *Greenscreen Dress*, or new ways of seeing an urban environment through *Datacatcher*).

7.1.4. RtD as Doing Experimental Postphenomenology

Thus far I described and unpacked an annotated portfolio of research products or RtD artifact inquiries revealing how they align with key postphenomenological commitments. I described empirical approaches across the research products, structures of human-technology relations they become part of, and, emphasized that they mediate human-world relations in any given

situation. Through this, I have established a postphenomenological vocabulary and concepts in the context of HCI and RtD, and sought to make the argument that research products can be seen as *doing postphenomenology*, albeit in a more experimental way. Next, I discuss this in more detail and describe the constructive roles HCI researchers can take on in their RtD inquiries.

First, we can consider *RtD as an 'experimental' way of doing postphenomenology* specifically because of its main commitment of the *crafting* of an artifact being an integral part of the inquiry. The actuality and high level of finish of research products allows them to be encountered and taken 'as they are' which means, in postphenomenological terms, that they mediate or co-constitute subjectivity and objectivity in any given situation. The crafting of research products allows HCI design researchers to investigate human-technology-world relations and technological mediations by not only studying them but also taking part in creating them. In this, research products can also challenge common postphenomenological understandings of human-technology relations and subjectivity and objectivity.

Second, the context in which research products are *studied* is co-constructed by the *choices* made around deployments, which extend postphenomenological ways of studying. Postphenomenological studies take empirical accounts of existing artifacts as the basis for their philosophical reflections. This offers a variety of existing contextual settings to be studied that have evolved around an artifact. Postphenomenological accounts often take on first person perspectives and, in a philosophical nature, are highly interpretative. This is in contrast to many HCI works that aim to produce a more objective account of the crafted and studied artifacts. The artifacts that I discussed are unique to the inquiry and counterfactual in nature. As such, it is not merely a new artifact that is studied but, with it, usually a newly mediated '*world' (objectivity)* and '*human' (subjectivity)*. Based on my annotated portfolio of six research products, I aim to offer an exemplifying (but not definite) account of how HCI design researchers can take on the co-constructive and multifold roles in their inquiries (see Figure 19).
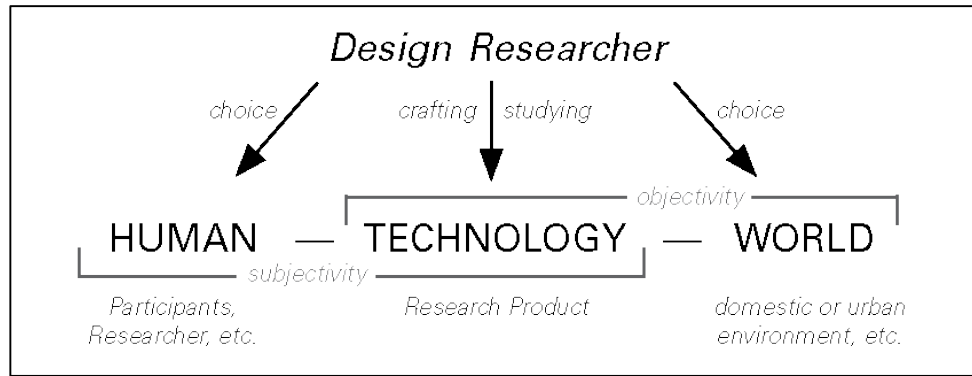
Figure 19 Constructive roles of HCI design researchers in their RtD inquiries.

The design researcher can intentionally *choose* an environment (*world)* for the artifact to exist in (e.g., a domestic environment with the *Photobox* and *Morse Things* or an urban environment with the Datacatchers). The researcher's choices also determine who encounters the technology. An empirical account can, for example, come from deployment studies with participants. As described, this can involve researchers choosing specifically skilled or trained participants (e.g., design experts in the *Morse Things* study, or philosopher households living with a *Titling Bowl*) or through introducing an additional interpretive voice (e.g., the service-design team for recruitment and the documentary moviemakers for data collection with the *Datacatchers*). Further, the researcher can choose to analyze her own experiential accounts as a *researcher-participant* (e.g., Pierce's experiences with the *Obscura 1C* and Mackey's experiences with the *Greenscreen Dress*), which further entangles empirical accounts, design artifacts, and theory. I believe this type of *interpretive empiricism* can better support efforts in the HCI community to reflexively report on lived experiences, relativistic accounts and mediations.

In summary, research products and their commitments to the *crafting* and *deploying* of artifacts is a generative, bespoke, and more experimental way of investigating human-technology-world relations and technological mediation. RtD artifact inquiries allow for philosophical reflection similar to postphenomenological inquires; and, they are also able to extend postphenomenological methodology in two ways; first, through their ability to *craft the object of inquiry*, and second, through their unique approach to studying technological mediation, and as a result creating inquiries that are experimental, generative, constructive, and anticipative. Accordingly, HCI design researchers can be seen as performing a kind of *radical empiricism* through the design and study of research products.

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Through the annotations and further discussions, I hope to have created a more graspable, design-oriented way of understanding postphenomenological commitments and concepts, which can further aid in this process of purposefully crafting technologies that mediate and become part of human-world relations. The theoretical nature and abstract concepts of postphenomenology as well as the novel way I used this framing impelled me to create a rather text-heavy annotated portfolio; although I had initially anticipated it to be more visual. I see an opportunity for future work to engage with the theoretical foundation and language I have laid out in a more visual way.

7.2. Limitations of Postphenomenology Informing Design-oriented HCI

In the beginning of this dissertation, I stated that I would take on a position of advocacy for postphenomenology as part of my exploratory and reflective design research approach. After conducting my investigations, I feel it is important to keep this position. Through the research detailed in this dissertation, I have found that postphenomenology productively shaped my thinking and doing as a design researcher. There are many opportunities to work towards generating more trials or endeavours of using postphenomenology and, thereby, making it easier to use for a larger group of HCI design researchers. My annotated portfolio project represents a step in this direction. I do believe that postphenomenology can valuably add to design-oriented HCI on a bigger scale in terms of complementing traditional or current approaches. However, it's important to acknowledge that I only applied postphenomenology in a small number of cases. Much more work is required to understand how postphenomenology could become more widely established within the HCI community. Next, I turn to a brief critical reflection on further use of postphenomenology in HCI.

I have experienced that philosophical concepts can sometimes seem abstract in the context of a more applied field such as HCI, and will say that it takes careful and informed thinking to use postphenomenology. More work is needed to generate more examples in this area. My dissertation has shown how it can be applied in the context of empirical qualitative and design-oriented research in HCI, which, while broad, both represent key opportunity areas for future work.

In the context of the postphenomenological annotated portfolio and inherent analysis of research products, six artifacts were purposefully selected. The selection process was mostly

based on the RtD projects that comply with the methodological commitments of *material speculations* (Wakkary, Odom, et al., 2015) and *research products* (Odom et al., 2016). Initially 14 artifacts[32] fit with the criteria and were analyzed. To keep with a recognizable, qualitative, and rich scope, only six were finally selected to make the portfolio, lastly, making sure they came from various sources. The portfolio showed clearly how postphenomenology can be applied to analyze, understand, and better see the human-technology relations HCI researchers generatively inquire into through and with their research artifacts. An interesting next step would be to see how this can also apply to other HCI investigations. Although I did not aim to prove a generalizability or applicability beyond that, I next turn to a brief critical reflection that moves in this direction.

Notably, a key aspect of the projects I looked at was that the technologies analyzed were realized systems and not merely concepts. The actuality of the research products allowed for lived-with accounts that were reported on through deployments in everyday contexts. These were then 'read' through the postphenomenological lens. I strongly believe in the value of the purposeful crafting of research artifacts and in the value of investigating actual accounts of relations and mediations that emerge through lived-with experiences. I think postphenomenology is particularly valuable when used in a *descriptive* way to study real things, phenomena, and how people may (or may not) relate to them.

With this in mind, I think it would be challenging to study a prototype that is less perceived as an actuality through the postphenomenological lens because assumptions around human-technology relations would be *speculative*. This is a practical limitation of a postphenomenological framing. However, thinking about speculation further, I can see that postphenomenology could at least help think about potential or even purely speculative futures through design projects. This is similar to material speculations, but I am thinking about even more 'staged' design-oriented projects, such as those that are common in numerous works of critical design (cf. Dunne & Raby, 2013). I believe postphenomenological concepts like technological mediation could still help think about and speculate on the potential human-technology-world relations a specific artifact could or would have the potential to shape.

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[32] The eight artifact inquiries I left out of the final annotated portfolio were: Drift Table (Gaver et al., 2004); Video Window (Gaver, 2009); Key Table (Interaction Research Studio, 2007); Tilting Bowl (which was later decided to actually be used as an informing example); Plane Tracker (Gaver et al., 2008); Fenestra (Uriu & Odom, 2016); Energy Babble (Gaver et al., 2015); Discovery Driven Prototypes (Lim, Kim, Jo, & Woo, 2013)

Figure 20 Critical design projects Respiratory Dog and Dialysis Sheep by Revital Cohen and Tuur van Balen (Cohen & Van Balen, 2008).

For example, the critical design project *Life Support* by Revital Cohen and Tuur van Balen, which centers around the question whether animals could be transformed into medical devices, exists as a critical speculation in the form of staged images of a potential future. The two examples shown in Figure 20 are the re-employment of Greyhounds as breathing aids and the use of sheep for dialysis. Although, this does not present an actuality, the high quality staged photos still represent a futuristic vision that is imaginable through the images. From this, I could see that postphenomenological concepts could help think about and speculate on for instance *what kind of human subjectivity and objectivity could be co-shaped by such a technological speculation*. This also shows, however, that reflecting on whether postphenomenology could add to the analysis of other technologies is a speculation and highly case-dependent. More work is needed to say anything more definite; and, a limitation of this dissertation is that it has not provided insights in this area.

As a last part of this section it is important to mention a few more things considering the limitations of postphenomenology in relation to design-oriented HCI. First, it took me a considerable amount of time to familiarize myself with postphenomenology, the fields thinking and doing as well as underlying concepts. It turned out, that conceptualizations although they were empirical which helped to make them more accessible, they were still abstract and not descriptive enough for HCI without further work (yet I hope that my work is a step in this direction). One thing that may not be depicted too well in postphenomenology are the dynamics around human-technology relations as studies rather emphasize conceptualizations around particular snapshots of situations of particular human-technology relations.

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I can see that other theoretical frameworks can potentially add to the complementary perspective I have developed for HCI through postphenomenology. For example, it may turn out that ANT emphasizes social aspects around human-technology relations further. This would be a potential extension of this work.

7.3. Insights for Postphenomenology

Lastly, I wish to reflect on how the body of work presented in this dissertation offers insights for the strand of postphenomenology in the field of the philosophy of technology.

The postphenomenological analysis of guide dog teams presented in Chapter 4 offers a cutting-edge case for philosophers of technology. Specifically, it illustrates how the postphenomenological notion of technological mediation is transferable to the mediation of an animate object or non-human—in my case an animal like the guide dog. In this way, the guide dog study case invites and offers to expand postphenomenological case studies towards including animate objects. Yet, the case example of guide dogs is still connected and building upon previous cases such as studies of the long cane discussed by Merleau-Ponty (1945) and hearing aid users discussed by Ihde (2007). Moreover, the guide dog case showed how animals exhibit an intentionality and it showed that they act as agents in people's everyday lives in complex and nuanced ways. Looking closer at cases like this offers potential to expand a postphenomenological understanding and conceptualizations of alterity relations.

Additionally, the guide dog case also presents itself as a *boundary case* by toying with a key concept of what a technology 'is' from a philosophical perspective. Ihde (1990) notes that technologies have a material component, enter 'a set of praxes', and create a relation between the technology and humans who use, design, make, or modify the technology. In Ihde's view, technologies are assumed to *be designed* and to *be functional*. In the case of the study of guide dogs' mediations, the notion that a technology is 'designed' is challenged. In the case of the table-non-table, the notion that a technology is 'functional' is challenged. Although the research artifact functions, it does not do so in the service of human use. Postphenomenological studies normally do not study unfamiliar technologies like this that do not have social norms established around them.

By challenging key concepts of technology, both cases can be understood as *boundary cases* or *boundary phenomena* of technology. The two cases were productively studied with the

lens of postphenomenology and particularly *mediation*; and, this illustrates how they successfully organize human-world relations. This shows that even though a technology is not entirely designed and not entirely functional, one can still use postphenomenological concepts to make sense of them.

In the case of the table-non-table, another dimension can be seen as a way of advancing the field of postphenomenology because it adds a more experimental dimension to doing philosophy than which is typically embraced within the field of the philosophy of technology (cf. Ihde, 1986). As described earlier in this chapter, the generative inquiry of *research products* can be understood as *doing postphenomenology or philosophy by generative means* (cf. Hauser, 2018). Generatively crafting things and, thereby, generating entirely new human-technology-world relations offers new ways to engage with postphenomenological concepts. This kind of design research practice can bring to postphenomenology the opportunity to proactively design a technological artifact and tailor it to an inquiry as I did with the table-non-table. This is a step proposing to extend postphenomenology beyond solely focusing on retrospective studies of existing artifacts towards embracing a generative outlook on investigating speculative or novel design artifacts.

Finally, HCI design research practice offers in-depth and innovative empirical methodologies to study the relations between humans and technology and engage with technological mediation. This can surface concrete and detailed accounts of human-technology relations that hold implications that can inform, affirm, or challenge postphenomenological concepts.

7.4. Concluding Remarks

In this chapter, I offered an account of postphenomenological commitments and concepts through an annotated portfolio describing and articulating how they are expressed across a number of RtD artifact inquiries. My goal was to advance or vertically ground the idea of seeing the empirical efforts of research products as an *experimental way of doing postphenomenology* or in other words *doing philosophy through things* by making this theoretical framework more intelligible and actionable to other HCI researchers. Particularly, the utilization of annotated portfolios enabled a concrete way of showing conceptual themes that I found could be scalable to HCI research. As a result, these philosophical concepts can be better leveraged in future HCI research inquiries, particularly with attention to forming a deeper understanding of people's

'interactions' with technology and looking beyond human-centeredness. Moreover, the demonstrated value of postphenomenology advances HCI particularly in the way it speaks to the understanding, discussions, and positioning of RtD and more generally the study of human-technology relations.

There are similarities and a mutual interest between RtD inquiries and postphenomenological ones. Both approaches at their core investigate technologies and the relationships humans have with them. Further, RtD offers a promising methodological path to uncovering and investigating mutual concerns of postphenomenology and to looking beyond use, interaction and human-centeredness, and to forming a deeper understanding of people's experiences and relations with technology. The making and studying of research artifacts provides concrete ways to advance new knowledge on how complexities of human-technology relations can be productively approached. In line with work that has come before (Pierce & Paulos, 2015b), I see the inquiries of such empirical efforts with speculative design artifacts as an *experimental way of doing postphenomenology* or in other words *doing philosophy through things*. I discussed this further in section 7.3 when offering a reflection on how this dissertation offers insights for the field of postphenomenology.

Chapter 8.

Conclusions, Contributions and Future Research

In this last chapter, I will first summarize this dissertation and its core contributions in sections 8.1 and 8.2, and second, I will prospectively reflect on ways this dissertation can inform future work with particular attention how it can speak to a future *posthumanist discourse in HCI*.

8.1. Summary of this dissertation

This doctoral dissertation presents a reflexive account of a design researcher exploring a way to complement human-centered approaches in design-oriented HCI through postphenomenology. The *main research objective* of this doctoral work was to explore whether *postphenomenology could contribute a holistic perspective on human relations with technology that can help complement and expand human-centered approaches to design research and practice?*

I addressed this research objective in two ways; first, by drawing on two cases of my own design research practice: (a) the studying of guide dog teams and (b) the field deployments of the table-non-table, which both in their own way challenge aspects of human-centeredness, and second, through the use of postphenomenology as an analytical lens to study and analyze these cases.

In Chapter 1, I introduced my research objective to conduct an exploratory investigation into what a postphenomenological perspective might hold in complement to human-centeredness in design-oriented HCI, my main discipline and field of study. It was my attempt to address the research objective in two ways; first, by leveraging two cases of my own design research practice: (a) the studying of guide dog teams and (b) the field deployments of the table-non-table, which both in their own way challenge aspects of human-centeredness; and second, through the use of postphenomenology as an analytical lens to study and analyze these cases. I posed two main research questions:

1) *Can postphenomenology provide the design-oriented HCI community with a valuable holistic view of human-technology relations in complement to human-centered approaches?*

2) *What is revealed about human-technology relations when postphenomenology is utilized within design-oriented HCI research?*

In Chapter 2, I discussed related works grounding and motivating this research endeavour. These works mainly come from the field of HCI (particularly design-oriented HCI) and also the philosophy of technology, particularly postphenomenology, as it is the chosen theoretical framework I attempt to utilize in my research.

In Chapter 3, I detailed the methodological and epistemological commitments of this dissertation, which presents a reflexive account of me as a design researcher integrating postphenomenology as an analytical lens to complement human-centeredness in the context of design-oriented HCI. This research is of qualitative nature; it is creative, exploratory, and relying on a 'researcher-designed framework' that is unique to this dissertation.

In Chapter 4 and 5, I presented my two research cases. The first research case was the *retrospective analysis of the guide dog teams study* using postphenomenology as an informing theoretical lens. This case enabled me to contrast the human-centered and the postphenomenological approach to studying guide dog teams. The second design research case was the *Field Deployments of the table-non-table*. In this case, the analytical lens of postphenomenology was introduced mid-way throughout the field deployments performing another deployment informed by the theoretical framework. In comparison to the first case, this case presented a progression rather than the contrasting of two approaches.

In Chapter 6, I discussed the collective findings of the two cases and turned to answering the research questions. I first examined the lessons learned from the two research cases respectively, and thereafter, based on postphenomenological notions of human-technology-world relations and related concepts, I specifically describe insights for HCI.

In Chapter 7, I generalized or vertically grounded some of my research findings. First, I extended the conceptualization of the table-non-table *as a postphenomenological inquiry* towards generating a synthesized analysis of six other contemporary RtD projects in an annotated portfolio. This opened up new ways of looking at them and provides a scaffolding for future research opportunities. Second, I discussed how this work can be of value to and extend the field of postphenomenology.

In Chapter 8, I conclude this work by providing a thorough summary and by illustrating how the research questions were addressed. Furthermore, I discuss as an avenue for future work how this research can be seen as a posthumanist exploration in the context of HCI.

8.2. Achievement of Proposed Goals

Considering a postphenomenological perspective in the context of the HCI community, one can ask: *Could postphenomenology contribute a holistic perspective on human relations with technology that can help complement and expand human-centered approaches to design research and practice?*

Motivated by this overarching question, as an HCI design researcher, it was my goal to conduct an investigation exploring what a postphenomenological perspective might hold in complement to human-centeredness.

The following two research questions were posed at the beginning of this dissertation:

1) *Can postphenomenology provide the design-oriented HCI community with a valuable holistic view of human-technology relations in complement to human-centered approaches?*

2) *What is revealed about human-technology relations when postphenomenology is utilized within design-oriented HCI research?*

Both questions were addressed throughout this dissertation, specifically through chapters four, five, six, and seven. With regards to the first question, the engagement with postphenomenology in the two research cases in Chapter 4 and Chapter 5 evidently showed that a holistic view of matters of concern to HCI can be provided. Specifically, this includes a thorough understanding of human-technology-world relations in a given situation studied. I developed insights into a "*Design-Oriented HCI Through Postphenomenology"* on the one hand by broadening the view of the human and on the other hand deepening the view of human-technology-world relations within the field.

More specifically, in the guide dog teams case, a postphenomenological understanding aided an enhanced understanding of the encountered hybridity in *handler–guide dog* teams, the different entities at play including the human and the dog, as well as the relational aspects

involved in *handler–guide dog–world* relations. This offered a novel non-human-centered and holistic way of understanding the human as part of human–non-human relationships and further moved investigations beyond interactions towards a more holistic or comprehensive way of understanding relations (rather than interactions).

In the case of the table-non-table, the postphenomenological analysis and framing gave precision and language to non-utilitarian notions of the human-technology relations arising through the table-non-table. The table-non-table case made clear that technologies have mediating effects beyond being purely based on functionality, use or instrumental values. Instead it showed that, through the existence of the table-non-table, we can analyze and describe mediating effects and how technology organizes the relations of humans in the world or co-constitutes subjectivity and objectivity.

The second question reaches more into specifics. What is revealed in design-oriented HCI through postphenomenology, as demonstrated in this dissertation, is a holistic perspective on the matters of concern to the field of HCI that can be complementary to previous ways of understanding. Postphenomenology opens up a view of the human that in one way decenters the human and puts technology and the mediating effect of technology at the center. In this, the human however is still a central concern. It is understood as technologically mediated. The subjectivity and intentionality of the human is co-shaped through the relations organized by technology. The way humans act in the world and understand the world is mediated by technologies (which HCI researchers are inquiring into). This perspective overcomes a narrow view of the human present in human-centered approaches and it can help HCI researchers get a more holistic view of the human taking into account the relations that in fact 'make' the human.

In conclusion, this dissertation makes two core contributions to advance design-oriented HCI research. First, it introduces postphenomenology as a novel analytical framing showing how it can productively complement design-oriented HCI research beyond purely human-centered approaches. This is done by utilizing postphenomenology as an analytical lens and further engaging with it throughout this dissertation. Second, this dissertation contributes three cases that specifically illustrate how postphenomenology can be of value as a productive analytical lens for HCI research: (i) by using it to retrospectively analyze an empirical design ethnography study in Chapter 4, (ii) by using it to analyze a Research through Design (RtD) deployment study in Chapter 5, and (iii) more broadly by using it to create a synthesized

analysis of a range of key prior RtD projects in an annotated portfolio to provide a scaffolding for future research opportunities in Chapter 7.

This work will contribute primarily toward scholarly development in HCI and interaction design research communities. Particularly it will be valuable to HCI design researchers who are interested in investigating how technologies mediate people's everyday experiences and actions in the world. This work will also hold value for design researchers interested in theoretical advancements in HCI design research practice. Secondarily, this work offers interesting and novel research case examples to postphenomenologists that can add to the body of case studies in their field and also provide new perspectives.

As a last step, next I prospectively reflect on ways this dissertation can inform future work. Specifically, I describe how this work adds to a nascent *posthumanist discourse in HCI*. In this, I suggest how postphenomenology can be viewed as a posthumanist framework and reflect on what this might imply for HCI. I will touch on other posthumanist works that have recently appeared in the HCI community. My goals are to make clear how there is value in using posthumanist lenses in the context of HCI research and to point to opportunities for future work. In aligning with a posthumanist approach to HCI, I further present an account with visual annotations of the roles of animals in my design research cases and trace how this can relate to other HCI works in which animals are part of.

8.3. A Posthumanist Perspective for HCI

In this subsection, I offer a reflection on how my work in this dissertation can also be seen as having applied a posthumanist framing in the context of HCI.

Postphenomenology can be understood as a *posthumanist* approach to the study of the role of technology and human-technology relations (cf. Braidotti, 2013; Dalibert, 2014). Therefore, this dissertation's work can be seen as having applied a posthumanist way of thinking and within the context of HCI. I see an opportunity for future work to articulate a movement toward *posthumanist ways of approaching in HCI* and more broadly open up a posthumanist discourse in HCI. This can help the HCI community to examine and critically question the notion of how the human is treated in HCI. For example, a postphenomenological

posthumanist[33] perspective fosters a radical repositioning and rethinking of the human and its relations to the natural world, society, and non-humans and artifacts. Works within this movement reshape and expand conceptualizations of *what it means to be human*, in part, through critically acknowledging and taking serious non-human entities and their relations to humans. This, for example, can help move past an exclusive focus on the dichotomy of humans being autonomous (i.e., 'in charge') and technology being merely instrumental.

As previously mentioned, traditional ways of HCI can be understood as *humanistic* (human-centered) ways of approaching the human and technology. A humanistic approach to technology typically includes notions around seeing the human as an *autonomous agent* or subject (cf. Olssen, 2003)[34]. Here, the human and human intentionality are seen as independent; and, non-humans are seen as dependent and instrumental. The postphenomenological posthumanist perspective distributes agency across the human and technology and views intentionality as inherently mediated. Through this expanded framing, a holistic perspective on understanding humans and technologies and the relations that come about between them can be a scaffolder for new research programs in the HCI community. This perspective brings forward a shift towards *decentering the human*, which several recent works have advocated for in the HCI and broader design research communities (e.g., Forlano, 2017; Jenkins, Le Dantec, DiSalvo, Lodato, & Asad, 2016; Jönsson & Lenskjold, 2014).

It is important to note that a decentering of the human is not a move against the human or taking the human less seriously; it is in fact the opposite. For instance, the postphenomenological perspective offers a holistic understanding and rich perspective of the human, taking into account relational aspects, the context they inhabit and most importantly the way in which technologies mediate or affect humans on a deeper level.

In a posthumanist perspective in which technology mediates the human and human intentionality, it becomes clear that HCI researchers and designers of technology are implicated in a deep responsibility. As Verbeek states: "Designing technology is designing human beings:

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[33] Posthumanism is a broad and complex area. In this chapter, I briefly touch on it to suggest using it as a lens for future research in HCI. Please refer to selected contemporary works for more detail (e.g., Braidotti, 2013; Wolfe, 2010). Additionally, posthumanism is related but should be differentiated from transhumanism (the biotechnological enhancement of humans) and definitions of *the posthuman*, the human transcending materiality.

[34] Foucault is one of the main figures to criticize the autonomous subject in western philosophy.

robots, vacuum cleaners, smart watches—any technology creates specific relations between its users and their world, resulting in specific experiences and practices. […] The design of interactions therefore implies not only the design of technological objects that allow for specific interactions, but also the design of the human subjects who interact with these objects" (Verbeek, 2015, p. 28). In light of this, it seems like an apt opportunity for the HCI community to take a stance in and contribute to this posthumanist debate.

In addition to postphenomenology, many other advancements through uses of theoretical and analytical lenses can be looked at as posthumanist ways of thinking, a number of which are already being incorporated in the context of HCI. Examples include: *animal-computer interaction* (e.g., Aspling, 2015), *the anthropocene* (e.g., Smith, Bardzell, & Bardzell, 2017), *somatechnology* (Dalibert, 2014; Höök et al., 2016), *object-oriented ontology* (e.g., Giaccardi, Cila, Speed, & Caldwell, 2016; Wakkary et al., 2017), *Actor-Network Theory* (e.g., Aspling & Juhlin, 2017), *transhumanism* (Eisenberg, 2017), and *non-anthropocentrism* (DiSalvo & Lukens, 2011). Collectively, these works show that posthumanist works in HCI are emerging and diverse but remain scattered and less unified; their connection to the HCI community as a research program remains under-developed. Only a handful of recent HCI works explicitly frame their research in relation to posthumanism (e.g., Aspling, 2015; e.g., Devendorf & Rosner, 2015; Jackson & Kang, 2014; Smith et al., 2017).

Related to posthumanist perspectives, as mentioned, is the inclusion and taking into account of other agents such as animals. Animal-Computer Interaction (ACI), which advocates for this, emerged as a discipline that "aims to take what, in HCI, is known as a user-centered approach to the design of technology intended for animals, placing them at the center of the design process as stakeholders, users, and design contributors (Mancini, 2017, p. 221). In 2018, the fifth ACM international conference on Animal-Computer Interaction (ACI2018) is being organized. ACI and other efforts including animals in HCI and design research works (e.g., Bell, 2016; Hjorth, Horst, Galloway, Bell, & Galloway, 2017; Höök, 2010; Smith et al., 2017; Tucker & Bell, 2016) clearly point to a stance of taking animals more seriously in HCI research and advocate for a less anthropocentric view in which the agency of animals (and other non-humans) is taken into account. HCI initiatives related to animals can include designing for animals, designing technology to mimic animal behavior, designing tools to study animals, or designing animal-technology interactions for humans (cf. Smith et al., 2017).

As earlier stated, in both of my research cases animals played important roles. In the guide dog teams case dogs are a key part of the study and the relationships I investigated. Initially, I came up with design implementations to improve human-animal interactions in guide dog teams, for example by designing accessible dog toys. In my postphenomenological analysis, I viewed the dogs as non-humans and looked at their mediating effects, how they shaped the visually impaired handlers and their lifeworld.

Applying a postphenomenology-inspired perspective on my Guide Dog Teams Study allowed me to view the dog as a transformative non-human mediator. This enables a perspective to more keenly pay attention to the agency, intentionality, and co-shaping influence of non-humans like animals. Even if we, the HCI community, are mainly interested in the interactions or relations between a human and a technology, family members of other species are part of a network of entities and relations that potentially offer more valuable insight into the domestic happenings of everyday life.

In the deployment studies with the table-non-table, pets played an important role in several occasions. Pets including cats, dogs, and rats who co-inhabited participant households often influenced participants' engagements with the research artifact. Pets interacted with the table-non-table and had their own impacts on the happenings around the artifact in the homes. This was in some cases an icebreaker for the participants or more broadly presented situations and behaviours to participants they could reflect on. Having also seen a few instances of related HCI works in which pets played a role in similar ways, I see an opportunity for paying more attention to that.

The pet household members could be seen as co-generating insight about living with the table-non-table. For instance, I found that participants observed or tried to imagine what their pets 'think' about the new thing in their life and home from early on in the studies. Several participants provided pictures of the artifact and their pets (see for example Figure 21).

Figure 21 Pictures participants shared of their pets in the first few days of living with the table-non-table in their home.

Several participants explored the nature of the table-non-table in collaboration with their pets (see for example Figure 22 and Figure 23).

Figure 22 Participants exploring what the table-non-table is and does with their pets.

Through such interactions with their pets, participants formed thoughts and reflections around the artifact. An excerpt of a blog post of one of the participants illustrates how her cat influenced her to think about the table-non-table by reflecting on what the cat maybe 'thought':

> *"Louie the cat has definitely been thinking about the [table-non-table] and applied that thinking even to another appliance in our house. We have a tiny space heater that we use in our attic and sometimes in the living room […]. For Louie, the space heater and the [table-non-table] have a few things in common. Both are appliances that have a cord that leads away from the appliance (almost like a tail). Both make a buzzing sound every once in a while. […] [A]t some point Louie started to act really weird around the heater and he had not done that in the past, which is why I think it has to do with his thinking about the TNT. He started to watch the heater closely. Walked around it and sat in front of it watching it [for a while]. [see Figure 23]*
>
> *I think he might be waiting whether it would move also. I'm thinking he thinks the heater also 'is alive' [like the table-non-table. He probably is waiting and watching to see if it will also move. The TNT has definitely influenced a part of Louie's life view and reasoning."*

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Figure 23 A participant's cat seems to be waiting for a heater to move after having experienced the table-non-table which has qualities that are similar to the space heater.

This example illustrates how participants' pets as household members add in a co-generating way to the accounts researchers can receive from participants. Notably, given the non-utilitarian aspects of the table-non-table, I inquired with a research product without a clear purpose (from a participant point of view), yet there were a number of observations of pets discovering important and insightful perspectives seemingly exploring the table-non-table's 'use' to them.

In addition to my own study with the table-non-table, other RtD artifact studies showed evidence of pets being part of deployment studies (see examples in Figure 24).

Figure 24 Four cats sitting on or next to research artifacts of HCI research inquiries. a) the table-non-table; b) the Photobox, ©William Odom; c) the Key Table, ©Interaction Research Studio; and d) the Local Barometer, ©Interaction Research Studio.[35]

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[35] For more information on the Photobox, please see (Odom et al., 2012). For more information on the Key Table and Local Barometer, please see (Interaction Research Studio, 2007)*.*

Evidently, pets are part of the domestic spaces in which HCI researchers deploy or study research artifacts. My own study showed that pets can co-generate and influence participant's accounts of living with a research artifact like the table-non-table. However, this is rarely discussed or engaged with in a more serious manner in HCI works. Considering this and also my postphenomenology-informed investigations of guide dogs, I see ways of paying closer attention to such nonhuman subjectivity, and doing so potentially through a postphenomenological or more broadly posthumanist lens. Taking animals more serious as agents and as mediators can be a potential avenue for future work looking to study artifacts or products in domestic settings.

Given that the boundaries between humans and technology and non-humans are becoming blurrier and that humans and technology are inherently intertwined and mutually shaping each other, the integration of posthumanism in HCI is a major opportunity area for future work. One area I discussed further is the idea of taking animals and their perspectives more seriously into account.

There is an opportunity for a thorough review of applied posthumanist theory in HCI as well as a further developed position on what posthumanism as a lens holds for HCI or what a field development towards *posthuman-computer-interaction* could hold.

As a last remark, throughout this dissertation, I have both explicitly and implicitly described areas for future research and practice initiatives. I am excited to pursue many questions raised and opportunities opened through my dissertation for the fields of HCI, design, and the philosophy of technology in my future work in *design-oriented HCI through postphenomenology* and also *posthumanist HCI*.

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Appendix A.
Case I: Studying Guide Dog Teams

A.1 Study Design of the Original Guide Dog Teams Study

Research Question

At the beginning of the research the research question that was posed was:

> *What are the routines and tasks of guide dog owners and how can technology design help them support their routines?*

Pre-analysis

The pre-analysis consisted of a literature review covering research and practice in HCI and design communities, as well as studies from a range of disciplines outside of HCI.

Planning the study

In the planning phase the ways of participant recruitment and data collection were determined.

Participant recruitment

Through word-of-mouth, social media, the Canadian National Institute for the Blind (CNIB) and Access for Sight Impaired Users (ASIC), twelve guide dog users were recruited; they all lived in or close to Vancouver, were aged between 21 to 67. We also recruited an expert whom is a founder of a guide dog school and has been working in guide dog training since 1977.

Data collection

Data was collected through interviews and observations with the guide dog users, as well as an interview with a guide dog expert. We conducted in-depth interviews and observations with the guide dog users. Interviews were semi-structured and conducted in the participants' homes. Questions were about the guide dog handlers, the dogs and their life, exploring routines, tasks, activities, play and challenges. Moreover, questions targeted the use of and relationship to technology. The observations explored interactions of guide dog teams both in the home and outside. In order to get a detailed understanding of their practices and routines we spent between 2.5 and 4.5 hours with each team, depending on their willingness and comfort.

Documentation

The data was documented through audio recordings, video recordings, handwritten notes, and transcriptions of important parts from the audio recordings.

Data analysis

All field recordings were reviewed and information most relevant to the study focus was transcribed. Through thematic analysis, we identified several pertinent categories within the data. To provide a coherent narrative, we present the findings from both our expert (referred to as X01) interview and guide dog user (P01-12) interviews together.

Findings

The findings we drew from our data. An important observation segmented interactions between guide dog teams into two main scenarios. They are either working or off work. A clear indicator for these modes is the harness, which the dog is wearing while working and typically not wearing while off work. We reported on those different scenarios, their individual aspects, experiences, and challenges. Further we described the development of strong bonds in guide dog teams as a pertinent theme as well as technology usage of guide dog teams.

Design Suggestions

Our design suggestions were targeted at supporting working guide dog teams (1), supporting play-interactions of guide dog teams (2), and lastly discussed speculative and explorative opportunities for designing for guide dog teams.

A.2 Data Collection Guide of the Original Guide Dog Teams Study

DATA COLLECTION, GUIDE DOG TEAM STUDY 2012/2013

<u>**INTERVIEW GUIDE**</u>

1. Interview setting information

- Date, time,
- Participants, name, contact information, address
- Location of interview: (preferably at home of participant).

2. General questions about the person

- Age, profession, background information
- Visual Impairment, percentage of vision, early/late blind? Cause of impairment?
- Home/Living situation: Do you live alone? What type of home? Size? Style?

3. Questions on technology usage

- What kind of technology are you frequently using?
- What kind of cell phone do you have? What kind of computer/software?

4. General questions about the dog and and general guide dog experience

- Name, gender, breed, age
- Is this your first guide dog/which number of dog is this? / For how long have you had this guide dog?
- Which organization is the dog (and were previous dogs) from?
- Can you tell the story of how you got this dog (and also story about other previous/first dogs)

5. Questions on the human – guide dog relationship

- Can you tell me more about the relationship between you and the dog? How do you feel about the dog?
    - Are there specific moments you felt especially [grateful] for your guide dog? Tell me the story
    - How would you describe your bond with your dog? How would you say the relationship between you & the dog differs from a sighted-human-dog relationship?
- Do you see differences between the working and the off-work relationship between you and the dog?
    - In the way you feel about the dog? In terms of discussed attributes: pride, reliability, … etc.?
- Where do you see the most challenges in your relationship with the guide dog?
- Is it easy/difficult to provide your guide dog with the privileges of a dog's life?
    - How about for instance playing (e.g. any challenges with toys)?

6. Questions on routines, tasks, and challenges

- Tell me about a typical day in your life. What are the types of things you do? (hobbies, habits, etc.)
- Follow up with a routine question: What activities that you just told me about are routine? Which aren't? In which of your activities & routines is/ isn't the dog involved?
- What are the dogs tasks he/she helps you with?
- Are you doing a lot of activities with the dog that aren't working tasks? Such as playing, dog walking?
- Are your tasks (and any other activities you do together) planned or more spontaneous?
- Are there any tasks you can think of in which you need the help of others (not the dog)?
- Are there any tasks you can think of you wish your dog could help you with, but can't?

<u>**OBSERVATION GUIDE**</u>

Ask the participant about observing specific tasks s/he accomplishes with the guide dog both in the home and outside.

Decide together which tasks will be observed, i.e. going into a store, etc. Videotape the observations!

Pay special attention to the following:

- Limitations/ challenges that the participant might not be aware of.
- What are the interaction/communication patterns of the situation?
- What seems worth highlighting?

A.3 Guide for an Analysis of Relational Structures

Relation Analysis
to uncover what kind of human-technology relationships are at play (or are absent), and to come up with scenarios for further analyses

	Human-Technology-World relationship OR postphenomenological descriptions of guide dog team relations.			
	Human – Technology – World			
	// use scenarios with relational analysis. // distributed into their existential and hermeneutic dimensions (Verbeek 2005) domains of mediation (Verbeek 2013)			
	p.4: "individual and social mediations of technologies do not only help to shape the practices and experiences of individuals, but also inform social practices and frameworks of interpretation". –- Verbeek 2013			
Relationship	**Description**	**Which relationships are at play in which scenarios?** *//comparisons with other technologies can help*	**more description** *//possibly determine actants of constellations*	**Further analysis if possible**
Embodiment	Human – Technology – World (Ihde 1990) --> Human – Technology = World (Human – Technology) → World			FIELD OF AWARENESS (Rosenberger) Transparency: ... Field composition: ... Sedimentation: ...
Hermeneutic	Human → (Technology – World)			
Alterity	Human → Technology (– World)			
Background	Human (– Technology – World)			

A.4 Guide for a Mediation Analysis

Mediation Analysis

*to look at mediation in a specific situation, and gather mediating effects (and sort into '**domains of mediation**')*

// This kind of analysis can really help you to analyse a scenario and what is going on (mediation wise) in an in-depth way. Brings it together, to create links, lessons, generate knowledge

DOMAIN OF MEDIATION	hermeneutic + amplify / - reduce this is how 'the world' is to the human			existential + invite / - inhibit this is how the human is in the world and does	
	deeper understanding of the world and motivation. Technology changes the way you see the world...			*influence of technology and how it inhibits or invites you to be a certain way and do certain things*	
	Frameworks of Interpretation (social level), Interpretation (of the world)	**Perception, Experience (individual level),**	**Technology**	**Action/Behaviour (individual level),**	**Social Practice (social level), engagement (with the world)**
general questions to be answered	How does *this technology* amplify or reduce any interpretation of yourself or your environment, your societal reference framework, your understanding of society and what is around you?	How does *this technology* affect your perception, what you perceive? What kind of experiences and perceptions are amplified/ what are reduced by *this technology*?	**Human-Technology 'Use' (intentional or unintentional) Scenario(s)**	What kind of behaviour or actions does (using or having or living with) *this technology* invite you to? What kind of behaviour or actions does (using or having or living with) *this technology* inhibits in you?	What kind of social practices or more borad engagements does *this technology* invite you to? What kind of social practices or more borad engagements does *this technology* inhibits in you?

A.5 Partially Filled out Mediation Analysis of Guide Dogs as transformative Mediators

Mediation Analysis

*to look at mediation in a specific situation, and gather mediating effects (and sort into '**domains of mediation**')*

// This kind of analysis can really help you to analyse a scenario and what is going on (mediation wise) in an in-depth way. Brings it together, to create links, lessons, generate knowledge

DOMAIN OF MEDIATION	hermeneutic + amplify / - reduce *this is how 'the world' is to the human*		Technology	existential + invite / - inhibit *this is how the human is in the world and does*	
	more deeper understanding of the world and motivation. Dog changes the way you see the world…			*influence of dog and how it inhibits or invites/enables[only really talks about functionality! But in mediation we also talk about the' influence on agency'*	
	Frameworks of Interpretation (social level), Interpretation (of the world)	Perception, Experience (individual level),		Action/Behaviour (individual level),	Social Practice (social level), engagement (with the world)
Main domain questions to be asked studying guide dog teams	*How do aspects of the dog mediate (amplify/ reduce) the perception and experiences of the self/ the dog/ worldly aspects like environment, material things, people etc.?*	*How do aspects of the dog mediate (amplify/ reduce) the (individual) perception and experiences of the self/ the dog/ worldly aspects like environment, material things, people etc.?*	*Guide Dog Teams' use scenarios*	*How do aspects of the dog mediate (invite/ inhibit) the handler's (individual) actions and behaviors?*	*How do aspects of the dog mediate (invite/ inhibit) the social practices of their handler's (on a social rather than individual level)?*
some of the results of a mediation analysis in guide dog teams with previously collected data	• Guide dogs **amplify** the feeling of being an independent person and more integrated part of society. • Being able to go places independently opens up that segway. • Other people (strangers) more often tend to talk to them because of the dog (icebreaker), they feel more integrated. • The feeling of traveling through people, being out, but feeling very separated and lonely is **reduced.** • People can relate to them over the dog • That way gudie dogs **reduce** the feelings of being alone, being dependent on other members of society, etc. in guide dog handlers	• The handlers understanding of travel and its possibilities changes completely through the dog. Possibilitys of travel are **amplified.** • perceiving and experiencing what is around is reduced and perceiving the dog's movement is **amplified.** • **amplifies** the way handlers see places (dog-friendliness, places to let the dog go to the bathroom. i.e. guide dogs mediate b/whandler and places, because it amplifies the perception. • guide dogs **amplify** access to the world, or in other worlds enable their handlers to have access to a part of the world. **(or is that invitation??)** • **amplifies** pride, confidence • Receiving less tactile feedback from their environment, the associated level of concentration and effort is greatly **reduced** with the guide dog as a mobility aid. • Guide dogs may **reduce** the way flooring is perceived (something more amplified in cane users. Due to their visual impairment, guide dog owners perceive certain things differently. In a unique way, when working with their dog's skills. By holding on to the harness, guide dog handlers get information about their dogs by feeling movements.Feelings through the harness are amplified, cognitive demand and resulting exhaustion is **reduced.** Traveling with a guide dog instead of a cane is less exhausting. Receiving less tactile feedback from their environment, the associated level of concentration and effort is greatly **reduced** with the guide dog as a mobility aid. Furthermore,	*Work mode: The guide dog is being use with the harness to go somewhere.*	• Guide dogs **invite** their handlers to be more keen on going places alone, possibly stay out longer, do more errands, … • Guide dogs **invite** for more independent and enhanced traveling possible. • Handlers can even fly places • The handler becomes a dog owner when deciding to get/use a guide dog and as such always will have to think about the dogs well-being while thinking about the world and activities etc. So, the handler is **invited** to include the dogs well-being when thinking about where to go and what to do. • A guide dog **invites** for more possibilities to engage with society • A guide dog **invites** companionship and nurtuting	Guide dogs **invite** for more social interaction and engagement, as people may be more likely to start talking. • Through enhanced travel guide dog owners feel **invited** to be more connected to society as they are able to do more things like others (go places) • Guide dogs change parts of the social practice of handlers, as they are in some ways increasing their contact to society through the gudie dog, and the dog also becomes a special connection to society. Others can relate to the dog and it can be a conversation starter. Guide dogs play significant roles in shaping owners' personal confidence and connecting them to their social context: A guide dog opens up more possibilities to engage with other people. For example, consider the following reflections from four different participants: *The dog has impacted my travel tremendously. […] When I think about my route into work. If I had to use the cane, I would need a nap when I got to work. It would be mentally exhausting. It is pretty remarkable to be able to travel that way. Pretty neat. [P04]* *The dog looks out for you and you don't have to think as much compared to the cane. It's very different. I often do compare walking with him, what it would be like with a cane and he makes it a lot easier […] so it's nice to have him to help me with that. [P02]* *A cane makes me feel disabled. With the guide dog I have confidence. She is my eyes. [P08]* *The dog connects me to people, he is the perfect icebreaker. With the cane you become invisible. [P06]*
	Reduces the feelings of pride, confidence, independence in a way.		*Off work: Guide dog is being interacted with but off leash*	**inhibits** the feeling of trust	
	Reduces the feelings of pride, confidence, independence in a way.		*Off work: Guide dog merging into background (e.g. sleeping, and obviously not being seen)*	guide dogs **invite** their handlers to be more mobile, more places will feel in reach. **Invite** to go out, to go more places. Guide dogs can **inhibit** their handlers to go to loud places, or places not well-suited for dogs. Cane users may visit concerts etc more often, whereas guide dog handlers will maybe simploy stay home with the dog or adjust activities.	

A.6 Data Collection Guide for a Postphenomenology-Informed Guide Dog Teams Study

DATA COLLECTION GUIDE, POSTPHENOMENOLOGY-INFORMED GUIDE DOG TEAM STUDY

Questions in this data collection guide can range from being more abstract to being more specific. They should be seen as guiding questions for further developed actual interviews and questionnaire guides.

<u>**INITIAL INTERVIEW I GUIDE**</u>

The first interview is to get to know the participant team, their background, present situation, and some routines.

1. Interview setting information

- Date, time,
- Participants name, contact information, address
- Location of interview: preferably in participants' homes or at handler's work place

2. General questions about the person

- Age, profession, background
- Visual Impairment; Percentage of vision, early/late blind? Cause of impairment?
- Home/Living situation: Do you live alone? type of home do you live in? Size? Style?

3. Questions on technology usage

- What kind of technology are you frequently using?

4. General questions about the dog and general guide dog experience

- Name, gender, breed, age
- Is this your first guide dog/which number of dog is this? / For how long have you had this guide dog?
- Which organization is the dog (and were previous dogs) from?
- Can you tell the story of how you got this dog (and also story about other previous/first dogs)

5. Questions on routines, tasks, and challenges (Collecting Use, Interaction, and Engagement Scenarios)

- Tell me about a typical day in your life. What are the types of things you do? (hobbies, habits, etc.)
- In which of your activities & routines is the dog involved? In which isn't s/he? What do you use the guide dog for? When do you not use your guide dog?
- How else do you interact with the guide dog? Are you doing a lot of activities with the dog that aren't working tasks such as playing, dog walking?
- How do you engage with your guide dog? How do you not engage with the guide dog?
- What challenges do you encounter when using/ interacting/ engaging with your dog?
  - Are there any tasks you can think of in which you need the help of others (not the dog)?
  - Are there any tasks you can think of you wish your dog could help you with, but can't?

6. Questions on the (bodily-perceptual) encounter with the dog, the human – guide dog relationship

- How does the person (bodily-perceptually) encounter the guide dog (in different situations)?
  - What is it like to **USE** a guide dog (possibly pick scenarios that were shared in previous section and get details on those scenarios)?
  - How do they encounter the guide dog? Do they embody it? Do they interpret it hermeneutically; do they 'read' the dog in any way? Do they encounter it as an alterity? Is the dog in the background? Where is the dog in relation to the participant? How are they interfacing?
- Also: What's happening with the person's awareness, what's on their mind (in those scenarios that are shared)
  - What do they perceive when [scenario]? What are they aware of? What is present to them, what is not?

- o E.g., As they're walking down the street with the dog/cane, what are they thinking about/ occupied by?
- Comparison to a similar technology:
  - o If you compare the guide dog with another mobility aid like the long cane, how do you feel using the guide dog is different in the way it transforms what you perceive?

7. Questions on (some of the more obvious) mediating effects of the dog

- What is it like to **HAVE** a guide dog? How does it transform aspects of your life? Can you describe ways you think using and having the guide dog affects you/has transformed you/your life?
- Can you tell me more about the relationship between you and the dog? How do you feel about the dog? (reliability, more acceptance in society…)
- Are there specific moments you feel or have felt especially grateful for your guide dog? Tell me the story.

OBSERVATIONS

Ask the participant about observing specific tasks s/he accomplishes with the guide dog both in the home and outside.

Decide together which tasks will be observed, i.e. going into a store, etc. Try to videotape the observations with additional support!

Observations can take place right after the first interview and also on additionally scheduled meet-ups depending on situations

chosen. Decide together, which tasks can be observed/shadowed, i.e. going into a store, getting a coffee, crossing a street, getting

on public transportation, going to a dog park, playing with the dog in a park or in the home, etc. It would be best if an additional

person could videotape what is being observed.

Pay special attention to the following:

- When observing situation ask yourself:
  - o what is the bodily-perceptual relationship between the person and the guide dog? What does the person perceive, experience, is occupied with, etc.?
  - o how the dog might be mediating in those situations?
- If opportunities come up, ask questions on mediating effects of the situations
- What are the interaction patterns/ engagements at play?
- Potential limitations and challenges, possibly the participant might not be aware of.

Interim Analysis

Through an interim analysis the investigator can take a look at collected use, interaction, and engagement scenarios and particularly

at the relations at play and mediating effects. This can help generate more specific questions.

- Pre-analyze some situations for bodily-perceptual relations and mediating effects.
- Generate questions on relations and mediating effects in question
- Possibly compare the analyzed with the use of a similar [technology] such as different mobility aid or having a pet dog?

INTERVIEW II

This second interview needs preparation time (i.e. interim analysis) and should be scheduled on a separate date. Below are

questions crafted with observed scenarios and challenges from the initial study in mind.

6. Questions on the Relations

THE EMBODIMENT OF A GUIDE DOG WHEN WORKING

- Do you feel like when you are using your dog on the street that s/he kind of becomes part of your body?

Transparency/ Withdrawal:

- What are you focusing on when traveling?
- When you are traveling with your guide dog, do you feel the dog is very present to you? How much does the dog withdraw, does it retain a very prominent position in the awareness? Are there specific aspects of the dog that fade into the background (which ones)?

Field composition:

- What demands conscious attention of you when?
- What composes what you are aware of while traveling/off-harness? What kind of information does the dog transform? What do you each look out for?

Sedimentation:

- How long does it take to get used to the guide dog way of traveling:
  - When thinking about the way it was with the long cane?
  - When thinking about the way it was with a previous dog?

HERMENEUTIC ASPECTS IN GUIDE DOG USAGE

- When traveling with the dog, what are you paying attention to specifically on the dog? E.g. the movement?
- What information do you receive 'through' the dog and in what way exactly?
- How much does the dog's individual personality play into this?

GUIDE DOG TEAMS OFF WORK

How about when the dog is off work/ harness is off, how does this change what we have just discussed?

- What do you perceive? What are focusing on?
- What is present to you? How present is the dog to you? Or how much is it withdrawn?

BACKGROUND RELATIONS WITH THE GUIDE DOG

- Does your dog ever go unnoticed by you, i.e. do you sometimes feel like subconsciously you know the dog is there but you don't consciously think off it. In a way, as if s/he merged into the background?

ALTERITY ASPECTS OF GUIDE DOGS

- Considering the several different ways of interacting and engaging with your dog, when does the agency or autonomy or personality of the dog being a living being and individual personality with intent come through?
  - Ask about at work and off work differences
  - How exactly do you perceive this autonomy in different situations?

7. Questions on mediating effects of guide dogs (considering the domains of mediation)

This section is to get a better understanding of how guide dogs shape their handlers lives, more particularly their actions (existence; existential) and perceptions (experience, hermeneutic) on an individual (micro) and social (macro) level?

The list of questions although extensive, may change according to the interview content, context, and answers given. With the list, we dive into each of these four sections individually. Each section starts with an abstract but thematic question followed with exemplary questions for interviews. These questions can range from being more abstract to more specific. However, the actual interview questions can take into account more specifics of a participant.

Priming: *All the following questions go more in-depth into the questions of:*
"What is it like to USE AND HAVE a guide dog? How does it transform aspects of your life?"

Questions targeted at better understanding the mediation of guide dogs on perception and experience on an individual level.
(Hermeneutic dimension)

How do aspects of the dog mediate (amplify/ reduce) the (individual) perception and experiences of the self/ the dog/ worldly aspects like environment, material things, people etc.?

- On an individual level, how does the guide dog affect what you perceive/ and experience?
- What kind of experiences and perceptions are amplified/ what are reduced?
- Comparisons to other mobility aids can be useful here, and be used as a before/after explanation!
- Do you feel in any way through the guide dog, your personality and/or your personal understanding of your identity has changed?
- Can you comment on the following feelings, when does the dog make or not make you feel: grateful, pride, reliability, trust, (working abilities), predictability, awareness, confidence, etc.

- Can you comment on your strong bond (companion, lots of time together, reliability and trust through working abilities, gratefulness and pride due to positive impact on live)?
- How does the relationship between you and the guide dog differ from a human-dog relationship of sighted teams?
- Do you see differences in the working relationship and the off-work relationship between you and the dog when you think about those feelings?
- How do you think does your lack of vision affect your relationship?

Questions to better understand the mediation of guide dogs on the handlers 'frameworks of interpretation, on a societal level.

(Hermeneutic dimension)

How do aspects of the dog mediate (amplify/ reduce) the (social) frameworks of interpretation of the self/ the dog/

worldly aspects like environment, material things, people etc.?

- On a societal level, how does the guide dog affect what you perceive/ and experience?
- Can you describe the impact of your dog on the ways you perceive your environment/yourself/guide dogs?
- Can you describe the impact of the dog on the way you understand/interpret what is around you
- Could you describe how having a guide dog has changed the way you think about yourself/ the way you perceive yourself and feel like how you could be perceived by others? How has the dog changed the way you feel as a member of society, the idea of the self, like how do you feel like it changes you and how you are in the world?
- Could you be 'grouped' (if you would group people in a society) differently? (Possibly ask further about what is amplified/reduced)

Questions to better understand the mediation of guide dogs on the handler's action and behavior, on an individual level. (Existential

dimension)

How do aspects of the dog mediate (invite/ inhibit) the handler's (individual) actions and behaviors?

- On an individual level, how does the guide dog affect your behaviour/actions?
- Does using or having the guide dog inhibit/invite you to do anything or behave in a certain way?
- Are there any things you did not do before getting your first guide dog that you now do (invitation)? Or things you did do and that you now don't do (inhibition)?
- Where do you see the most challenges with your dog?
- How about providing guide dogs with the privileges of a dog's life. Everyday needs of the dog and how they are met.
- How about playing (challenges with toys).

Questions to better understand the mediation of guide dogs on the handler's social practices, on a social level. (Existential

dimension)

How do aspects of the dog mediate (invite/ inhibit) the social practices of their handler's (on a social rather than

individual level)?

- On a societal level, how does the guide dog affect your social practices, i.e. your engagement with the world/reality/your environment on a broad level?
- What kind of social practices or broad engagements does the guide dog invite/ inhibit you to?
- You could think here about your interactions with other society members for example, and possibly compare your behaviour with how it was before you had a guide dog.
- Maybe a situation to talk about could be commuting to work.

Appendix B.
Postphenomenological Analysis of the table-non-table

B.1 Protocol of Second Study Series

DEPLOYMENT STUDY OF THE TNT
Study Protocol
April 2015

1. FINDING PARTICIPANTS
2. PART I – INVENTORY INTERVIEW
3. PART II – TNT INSTALLATION/ DROP-OFF
4. PART III – INTERMEDIARY DIALOGUE WITH PARTICIPANTS
5. PART VI – FINAL INTERVIEW

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1. FINDING PARTICIPANTS

The plan is to deploy the TNT to three homes for 6 weeks each in the summer of 2015. The timeframe for the deployments could look as follows:
1. April 27th – June 8th
2. June 10th – July 22nd
3. July 27th – August 7th

A flyer was designed to find the three participant groups. It will be deployed at a childcare, coffee shops, and yoga studios around Vancouver.
We are looking for the following participant groups:
- A family with smaller children (3-10 years old)
- A community living household
- A young couple (25-45)

We intend to not have participants that have a design occupation (graphic design, industrial design, architecture, etc).

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2. PART I – INVENTORY INTERVIEW + TNT INSTALLATION/ DROP-OFF

INVENTORY INTERVIEW
This first interview with the participants will take place before the TNT enters their home. It is to get an understanding of the people, their routines, and their home.

Two researchers will visit the participants at home. The idea is to get a tour of the home and gather data while doing that. One researcher should take inventory photos of objects, rooms, and places in the home, and the other one should ask questions about them and the participants' routines with or in them.

PREPARATIONS

Set up an appointment with preferably all participants/household members at home.
Ask for all members email addresses. Create a blog for the participants and prepare their instructions card with the access URL and password. Also, familiarize yourself with blogging on tumblr again, so you can teach the participants. Set up the tumblr access for all participants with their email addresses.

To bring: a camera, notebook for field notes, and a voice recorder. Laptop for tumblr instructions.

<u>INTERVIEW</u>
Note that questions can be seen as pointers to work from. They are divided up in themes.

THEME 0: UNDERSTANDING PARTICIPANTS AND THEIR EVERYDAY ROUTINES

Lets take a brief tour of the home.
Can you describe some of your favorite things here and why are they significant?
Why do you keep them here? (as opposed to somewhere else in the home?)
- Cataloging rooms, different significant things in the home, even in different rooms.
- Depending on the interview and the social setting, elicit reflections on a few different kinds of things (e.g., functional/utility, symbolic/meaning, old/heirloom/historical, little meaning/low attachment).

Can you tell me more about your everyday and/or weekly routines in the home?
- *What kinds of things do you (and your household) do in this room (and other rooms while going through them)? Together? Separate?*
- *Where do you spend the most time in the home?*
- *Do activities change often in your home?*
- *What's your favorite part of your home? Why?*
- *Is there somewhere that feels most like 'your place'?*

Ask for the email addresses of all participants for setting up the tumblr accounts. Set up immediately right there if possible.

TNT INSTALLATION/ DROP-OFF
The TNT will be brought to the participants home and the researcher will give them a quick run-down of the study again and give instructions on the tumblr blog use (preferably on a laptop) and with the prepared card. Encourage participants to post thoughts and actions and images of and with the TNT.

Where would you like it to go?
Give participants instructions on how to use the tumblr blog.
[Take images and then leave].

<u>WORK TASKS FOR RESEARCHERS AFTER THE INTERVIEW</u>
The researchers should create a photo inventory of the participants' home and objects. The researchers should also write a reflective memo after the interview that entails what s/he observed about the participants, their routines, and their home. This can be divided into preliminary themes that seem good to the investigating researcher at the time.

4. PART III – INTERMEDIARY DIALOGUE WITH PARTICIPANTS

The participants are hopefully using the blog to post about their thoughts and experiences with the TNT. The blog should be checked every day and blog posts should be replied to via email. The researcher can thank them for their post and share provoking thoughts or ask questions regarding the participants shared content. Through this e-mail communication participants know their interactions are important to the researchers and it may prompt them to post more.
Other than that, distance should be kept from the participants at this time.

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5. PART IV – FINAL INTERVIEW

PREPARATIONS
The photo inventory should be ready to go and printed.
The blog posts should be read and important ones that can be part of the interview should be printed for the researcher. After reading the posts, the researcher should go through the questionnaire and see what has been answered and where s/he could dig deeper in the interview.
The whole blog should be printed once as a reference for the participants if needed during the interview.

INTERVIEW
Note that questions can be seen as pointers to work from. They are divided up in themes.

THEME 1: GENERAL ON THE ACTIVITIES AROUND THE TNT; EXPLORING REFLECTIVE AND MATERIAL INTERSECTIONS

Has anything in your home changed since the artifact moved in?

Location of TNT
Can you tell us about where the object is living in your home?

Has it lived here the entire time? Have you moved it around?

Why has it lived here?

Where did it not go and why?

Can you tell us more about that?

- <<here I'd let participants take the conversation where they want. I suspect they may not know exactly what to say, although from the Kennedy's interview, the Dad became quite articulate quickly when comparing it to other technologies in the home>>

Have you moved things because of it, (ensemble thinking)

Behaviour of TNT (broad)
What has it been doing? (How does it interact with you?)

Did you ever notice it move? How did this make you feel?

Did you lave it plugged in the whole time? If you unplugged it, why and when?

Participants' Activities with the TNT
What did you do with it or what have you been doing with it?

Can you tell us more about what you day-to-day life was like with it?

- *How do you interact with it?*

- *Did you ever place things on it?*
- *Did the movement have an influence on your activities?*
- *Can you think back to when it first started living in your home… has the way you think about it changed or shifted over time?*
- *Did you ever simply contemplate what it was?*
- *Did the object lead to other action beyond it?*
    - *For example, social interactions? Material manipulations of the paper?*

- *Are there any places or spaces in the home that TnT wasn't allowed or didn't go? Why? <<here look for answers beyond practical reasons (e.g.,, couldn't go up stairs)>>*

Future thoughts

Are there things you can imagine doing with it (that you haven't done)?

Have you ever thought about what it could be?

Emotional aspects

Did it ever go unnoticed? E.g., did you ever forget it was in your home?

Did it ever annoy you? Or make you confused?

Did it bring happiness to the home? Did it elicit curiosity?

Any other criticism?

THEME 2: MATERIAL QUALITIES/ TENSIONS & THOUGHTS AROUND THE AESTHETIC OF TNT

How do you feel about the design of the artifact?

How do you feel about the materials that the object is made of? (e.g., paper, aluminum)

What did those materials make you think of?

Did different people (or pets) that lived around or with it experience it differently? Or, develop their own

ideas of what it is? Did you disassemble the object? (i.e., unstack the paper?)

Did you use the paper (may be answered in activities with the TNT)?

Does its form, and overall aesthetics feel appropriate for something that would live in your home?

Did your perception of the object change over time at all?

- *Were there aspects of the object that first felt unfamiliar, but became more familiar feeling over time?*

Do you think it relates to art?

Any other thoughts on it?

THEME 3: COMPLICATIONS AND DIFFICULTIES OVER RECONCILING WHAT IT 'IS' AND WHAT IT'S SUPPOSED TO 'DO'

What sort of role does the artifact take on in your home/household?

- *For example, what did it 'do'?*
- *In your view, what was it 'supposed' to do?*
- *Did you find any uses for it?*

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What does the fact that it is plugged in change (in how your relate to it and how it relates to other artefacts in your home)?

- If participants feel like it's not theirs:
What does it make you feel that it's not yours?

THEME 4: REACTIONS TO UNAWARE OBJECT & COMPARISONS TO OTHER TECHNOLOGIES

Comparisons

[Possibly good point to use object inventory for comparisons.]

How do you perceive or relate to the object in comparison to other digital and non-digital domestic artifacts.

How do you see the artifact related or compared to other technologies (digital technologies/ non-digital technologies)?

Does the object look like or feel like 'a technology' to you e.g., like the other technologies in your home?

- *Mobile phone; Television; Microwave; Computer; Book; Stool; Coffee table;*
- *also refer to technologies and objects already in the home*

How big of a presence would you say 'technology' has in your life?
- *How often do you watch TV?*
- *Check email?*
- *Use social media?*
- *Do you have a mobile phone? Where do you keep in when you're in your home?*
- *How often do you talk on the phone?*

Control
Coming back to the behavior of it, did you feel like you had more or less control over it than, for example, your mobile phone? A favorite book?

Does the fact that you have no control over what it does (i.e. it's behavior) shape the way you think about it? How? Why/Why not?

TNT's demands

How do you feel about the nature of the interaction with this technology?
What does it demand of you? And how does that make you feel or think about?

What does the fact that it is plugged in make you think about it?

WORK TASKS AFTER THE INTERVIEW
The researcher should write a reflective memo of the interview using field notes and the themes of the protocol.

A summarizing paragraph on the general perception of the participants (group and individuals) and details about them and their position and perception to/of the artifact at the beginning will help for co-analysis.

Important ideas and quotes from the participants can be added. The researcher can listen to the recording if needed.

B.2 Protocol of Postphenomenology-informed Third Study Series

RE-DEPLOYMENT STUDY OF THE TNT
Study Protocol
April 2017

PARTICIPANTS
PART I – INITIAL INTERVIEW + TNT DROP-OFF - 17.04.2017
PART II – INTERMEDIARY DIALOGUE WITH PARTICIPANTS & SELF-REPORTING TASKS - week 1-3
PART III – INTERIM INTERVIEW
PART IV – INTERMEDIARY DIALOGUE WITH PARTICIPANTS & SELF-REPORTING TASKS - week 4-6
PART V – FINAL INTERVIEW

The plan is to deploy the TNT to one home for 6 weeks in the spring of 2017. The timeframe for the deployment is
April 17th – May 21st

INITIAL PROPOSAL

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
17.04.2017	23.04.2017	30.04.2017	07.05.2017	14.05.2017	21.05.2017

ACTUAL STUDY

Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11
17.04.2017 card 1	23.04.2017 card 2	30.04.2017 X FB post	07.05.2017 X FB post	14.05.2017 17.05.2017 interim interview	21.05.2017	29.05.2017 card 3	05.06.2017	12.06.2017 card 4		12.06.2017 final interview

PARTICIPANTS

The chosen participants have a design background and occupation. **Amy** has a background in industrial/interaction design (BDes) and works as a designer and user insight expert @ Vancouver's Sparklabs R&D team. **Tom** has a background in design and architecture (BFA, BDes, MA Architecture) and works as an architect. (More info in appendix)

PART I – MEETING + INITIAL INTERVIEW + TNT INSTALLATION/ DROP-OFF
April 17th, 7.30PM 1918 Haro St, Vancouver, BC V6G 1H6, Canada. Buzz 208

1. PREPARATIONS
Schedule the meeting/drop-off (1-1.5h) with preferably both participants at home. Prepare self-reporting. Bring: a camera, notebook for field notes, a voice recorder (iPhone), printed consent form, the table-non-table :-), *pizza and a growler!*

2. EXPLAINING THE STUDY
- weekly stages, w/ foci/pointers to think about TNT in different ways; sometimes small design activity
- when possible, report on the secret FB group (text, images, videos). we're interested in everything!
- Flexibility: if at any time you're away or it's too much we can extend a weekly stage into 2 weeks
- we'd like to do: an interim interview (probably after 3 weeks), and a final interview (at pick up)
- get consent form signed

3. INITIAL INTERVIEW
Understanding participants, their beliefs, and their everyday routines
Lifestyle (incl.work)
- *Who are the participants? What do they do, their routines, what is their life like? → Could you each introduce yourself, tell us what you do for work, how you ended up working in that occupation, and also tell us what kinds of things you do on an everyday basis.*
- *Do you have specific everyday and/or weekly routines in the home?*
Home Life/Activities
- *What role does the home play in your everyday life?*
- *What kinds of things do you do in the home? Together? Separate?*
- *Where do you spend the most time in the home?*
- *Do activities change often in your home?*
- *What's your favourite part of your home? Why?*
Role of things in Home
- *Can you describe some of your favourite things/objects here and why they are significant?*
- *Why do you keep them here? (as opposed to somewhere else in the home?)*
- *Does the setup change or does it usually look like this?*
- *When acquiring something for the home, what do you consider?*
Role of things in Life
- *Outside of the home, what role do things/objects play for you?*
- *for example, what do you always take with you?*
Attitude
- *What are their beliefs, thoughts on: Technology, Design, Making*
- *Reflections on (e.g., functional/utility, symbolic/ meaning, old/heirloom/historical, little meaning/low attachment); maybe through things in the home. (E.g. Mix of old & new things)*

4. TNT INSTALLATION & EXPLANATION
INSTALL TNT → ask them where they'd want it to go. Ask to take a picture (before/after)

EXPLAIN THE TNT
Talk with participants about the TNT. What it is, how we would like them to 'see/view' it.
In our lab, we are exploring new ways of thinking about technologies in everyday life (as opposed to things in our lives). To do that we design objects that are taking on very different approaches. The table-non-table is one example of that. It's simple, made of paper, movement (stays w/in 1m^2), sturdy.   → Any questions?

5. REPORTING; SHARING WEEK 1 FOCUS
- *Focus 1st week: give the TNT a place in your home and life. first 1-2 weeks it's all about getting used to it being in your home and becoming part of your life (whether that's actively by you actually using it, or simply its presence, or when it is in the background...).*
- *Maybe imagine you purposefully acquired this and it is and stays yours. treat it as yours! YOU CAN do things with it, no need to ask.*
- *Facebook group to report and share thoughts, images, videos, …*
- *Cards: primers, to help think about stuff. if they have other thoughts, questions etc., they should please share them. Anything they do or think about is valuable information and insight to us.*

WORK TASKS FOR RESEARCHERS AFTER THE INTERVIEW
- write reflective memo

- During week 1: Check self-reporting. Create week 2 focus card.
- (Possibly share design exercise: **Design Exercise: Achieve Fit:** Given last week's main focus, are there ways (maybe a creative solution) that could help the TNT to achieve fit within your home and life?)
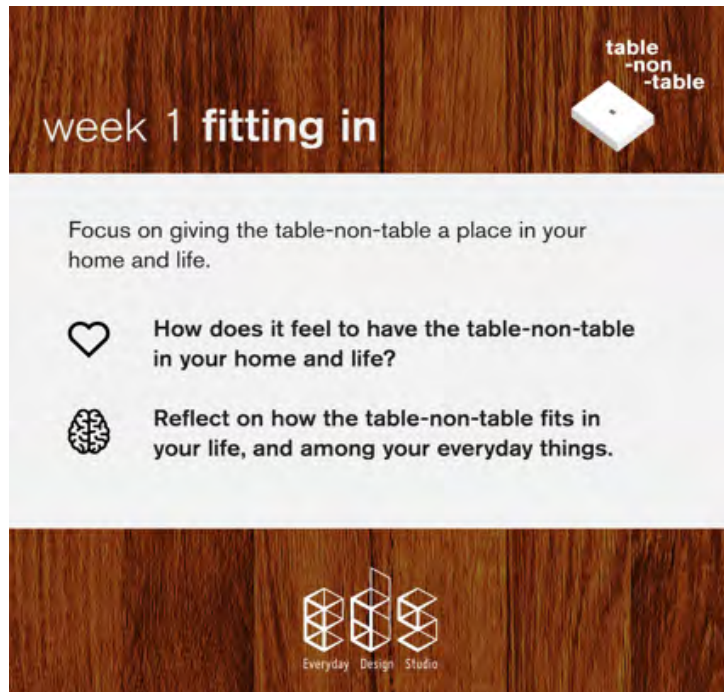- Later on: create a photo inventory of the participants' home and objects.

SHARING WEEK 1 FOCUS

> **WEEK 1** *Fitting In*
> **Focus** Focus on giving the table-non-table a place in your home and life.
> **Feel** How does it feel to have the table-non-table in your home and life?
> **Reflect** Reflect on how the table-non-table fits in your life and among your everyday things?

WORK TASKS FOR RESEARCHERS AFTER THE INTERVIEW
- write reflective memo
- Later on: they should create a photo inventory of the participants' home and objects.
- During week 1: Check self-reporting. Create week 2 focus card.
- Maybe introduce later in the week: **Design Exercise: Achieve Fit:** Given last week's main focus, are there ways (maybe a creative solution) that could help the TNT to achieve fit within your home and life?

PART II – INTERMEDIARY DIALOGUE WITH PARTICIPANTS & SELF-REPORTING TASKS (WEEK 1-3)

1. INTERMEDIARY DIALOGUE WITH PARTICIPANTS

The participants are hopefully self-reporting on the Facebook Group to post about their thoughts and experiences with the TNT. Researchers should check every day and blog posts should be replied to. The researchers can thank them for their post and possibly share provoking thoughts or ask questions regarding the participants shared content. Through this communication participants know their interactions are important to the researchers and it may prompt them to post more. Other than that, distance should be kept from the participants at this time.

2. SHARING WEEK 2 FOCUS

post on FB group on April 25th, 2017:

Thanks so much for participating and already reporting with all these interesting posts! Your task is to keep on 'living with' the table-non-table and integrating it in your home and life. Additionally, this week we'd like you to think about possible uses and functions (see this week's' priming card). If you have other things to share, everything is valuable and insightful information to us.

WEEK 2 *Use*
Focus Focus on exploring the idea of *use* with the table-non-table.
Reflection Can you see any specific function(s) or use(s) for the table-non-table?
Make Can you sketch an anatomy where you connect uses & functions of the table-non-table to aspects of its design?

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also post after card:

Here is an example of an anatomy sketch: https://silviacasali.files.wordpress.com/2012/01/anatomy04_1_feit.jpg

Anatomy of a Feit Goodyear Hiker

Let us know if you have any questions.

April 27, 2017: Afterthoughts: We're not really inquiring about indirect use, interactions, engagements, relations. The TNT is designed to be purposeless, therefore without use scenarios. Maybe a better focus would have been 'interactions'.

May 1st, 2017: Amy and Tom haven't posted anything on the last primer. We decided to open up the concept of use to encompass interactions and engagements.

Post after 1 week:
Hi Amy and Tom - owners of the table-non-table :),
We decided not to post a new priming card today but to expand on last week's a bit:
"When you think about 'use' with the table-non-table, please consider including less direct or deliberate encounters, interactions, and engagements."
Additionally, could we schedule a ~1.5 (incl. pizza&beers) interim interview with you two on any of the following: May 17th, 18th, 22nd, 24th or 25th?

Posted after 2 weeks on May 9th:
Hi guys,
Hope you are all well! We were wondering, if you had a chance to think a little bit about the table-non-table and 'use' (incl. less direct or deliberate encounters, interactions, and engagements)? If you have a few thoughts to share, please do 😊:).
If you have time to create a sketch of an anatomy illustration before the interview next week, that'd also be awesome. We're probably not going to give you another priming card this week. Thank you guys for all your efforts!! And keep sharing images if you have any! I wish we could also interview Cheeky & Chewy next week 😃:D.

PART III – INTERIM INTERVIEW - at (beginning of week 4)

PREPARATIONS
Given the shared participant data, and use scenarios, new questions should be generated with them.
The blog posts should be read and important ones that can be part of the interview should be printed for the researcher. After reading the posts, the researcher should go through the questionnaire and see what has been answered and where s/he could dig deeper in the interview.
?? The whole blog should be printed once as a reference for the participants if needed during the interview. A photo inventory should be ready to go and printed.

What we can work with, from the blog:

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- Chewy and Cheeky using the paper of the tnt.: ok
- 'paper to draw on': ok
- cognitive dissonance : ?
- crookedness 'I keep shuffing it back': ok
- co-constructing rat forts: ok

What we can work with, from the drop-off interview:
- Home working days > effect TNT
- Open to emotional attachment (Tom waffle iron)
- Open to everyday design (Tom)
- Open to mediation (Hue on waking up; aura of home)
- Try out ways of engaging with tech (eg. iPad sketch app)
- Open to metamediation (technology easy to 'overdesign', opposed to natural interaction)

INTERIM INTERVIEW
Pointers to work from. THEMES: Fit; Use; Mediation/Effect/Impact; Relations, Constructive thoughts

Starter: What has it been like to have the TNT in your home/life? (Are there any memorable events/ last week? Did you notice it yesterday?

FIT
Location of TNT
- Where has the table-non-table been located?
- Have you ever moved it around?
- Do you think is this a good place? Why/why not?

Behaviour of TNT
- Did you ever notice it moving? Did you hear it then? How did that make you feel?
- How did you deal with the crookedness, did you keep shoving it back? ("*Argh! It's crooked again!" … I keep shoving it backwards when it becomes crooked.*)
- Did you leave it plugged in the whole time? If you unplugged it, why and when?

Fit of the TNT
- Do you think the TNT has achieved some kind of 'fit' in your home and life?
  - o How do you feel now about the cognitive dissonance you experienced?
- Does its form, and overall aesthetics feel appropriate for something that would live in your home?
  - o [Focus on material]
  - o How do you feel about its design?
  - o How do you feel about the materials that the object is made of? (e.g., paper, aluminum)
- Were there aspects of the TNT that first felt unfamiliar, but became more familiar feeling over time?
- Can you think back to when it first started living in your home… has the way you think about it in terms of 'fitting in' changed or shifted over time? Does the TNT itself feel more familiar to you now?
- Could you see TNT to achieve a better fit within your home and life in or through any way?
- Were there visitors, how did they react, how did you explain?

USE (direct & indirect or deliberate encounters, interactions, and engagements)
Have you had a chance to think a little bit about the table-non-table and 'use' (incl. less direct or deliberate encounters, interactions, and engagements)?

Direct:
- What did you do with it or what have you been doing with it? How do you interact with it?
- Did you ever use the paper to draw on? [from FB: Week 1: "It moves, so I can't put it on the shelf or counter, but it has paper to draw on. I just can't think of a good place to put it."]
- Did you ever place things on it?
- Did you disassemble it?

Indirect:
- Have you moved anything in the home because of the table-non-table, (ensemble thinking), or since it's

been here?
- Did the fact that it was plugged in alter the things you did / could do around the TNT?
- Did the movement have an influence on your activities? How about when you each worked at home?
- Are you noticing it often?

- Any other interactions and engagements on your side (not the rats use)?
- Are there things you can imagine doing with it (that you haven't done)?

The Rats Use
- We know Cheeky & Chewey very quickly started using the TNT.
- How would you describe how the rats see the table-non-table, compared to other things? What kind of idea do you think they developed over what it is? What is it for them?
- You guys have put paper in places they can't drag it themselves (co-constructing rat forts).

Reconciling what it is
- Did you ever simply contemplate what it is?
- How would you describe the TNT in your own words?
- Thinking back to the beginning, has the way you think about it in terms of 'what it is' hanged or shifted over time?
- From a design perspective, what kind of technology space does it occupy? Or how would you describe this space?
- How does it compare to other technologies?
- Do you think the TNT has some kind of autonomy? Can you describe this autonomy? When does it come through? How do you perceive it in different situations?

MEDIATION
Priming: introduce how technology influences us everyday./ material environment has influence, such as Hue light changed the way they woke up, and 'aura' of apartment made you want it, affect your decision.

- Do any ways of how having the TNT has been affecting you come to mind?
- Are there specific moments that come to mind? Can you describe?
- [this is what the below is focusing on: Does using or having the TNT invite you to do/think/feel anything?]

Mediating space/home:
- has the TNT had an effect on how you see/feel in your home/space? OR feel about the home?
  - what kind of music genre rhymes with the effects of the TNT on the mood of the room?
- has the TNT had any effect on the activities in your home?
  - Did you change habits (e.g. cleaning, working from home, etc.)?
  - Did it change your home office activities?

Mediating (design/social) practice
Has the TNT in any way changed your everyday activities (outside/inside the home)?
Has the TNT had any influence on your design practice? (home=creative hide-away, inspiration in practice)
- Did you look at certain design objects differently? E.g. during Vancouver Design Week?
- Has it had an effect on your social practices? (topics in conversation, images shared on social media)
  - What if you would share a picture of the TNT on social media?

Mediating what participants think about/ do with other things:
- has the TNT had an effect on how you think about other things?
  - Did you notice new things about other things?
- has the TNT had an effect on how you use other things?
- *Aspects to focus on:*
  - o Control: Does the fact that you have no control over what it does (i.e. it's behavior) shape the way you think about it? How? Why/Why not?
  - o Demands: What does it demand of you? And how does that make you feel or think about?

RELATIONS
Priming: introduce how technology can withdraw or be present, like drawing tablet, 'embodiment'.

- When you think of this relation of you and the drawing tablet, how would you describe the way you relate to the TNT?

Mediating relation to itself
- Do you think the TNT has some kind of autonomy? Can you describe this autonomy? When does it come through? How do you perceive it in different situations?
- How about the TNT's presence? does it ever go unnoticed? Was there ever a moment where you knew the TNT was there, (but outside of your view), and knowing that caused some kind of effect?

CONSTRUCTIVE THOUGHTS
- Are there functions you wish the TNT would have? / uses you wish the TNT would support?
- How would a home be with more / only objects like the TNT?
- Material Qualities/ Tensions & thoughts around the aesthetic of TnT

OTHER
- ?Broader reactions to the study (at this point in the deployment)

Ask for the the video to be sent via email!

3. SHARING # 3 FOCUS

week 6 **design challenge**

Make use of a part of the table-non-table

We would like to ask you to challenge yourself and think about how the table-non-table paper could be used in 5 different ways and document your ideas. We suggest doing this on 5 consecutive days.

IDEAS FOR UPCOMING WEEKS!

4. SHARING # 3 FOCUS

week 9 Update and Creating a Collection

Answer the following questions
1. Where is the table-non-table located at the moment?
2. Is it plugged in?
3. Did any new engagements or interactions with the table-non-table evolve?
4. Did the interactions of Chewey and Cheeky with the table-non-table change after it moved into the bedroom?
5. Are there any new images you can share?
6. Is there anything else to report?

Make ***Create a Collection*** Re-design 1-2 things of your everyday things so they in some way 'go with' the table-non-table. For instance, you could transfer a specific aspect of the table-non-table onto another thing. Please, create a sketch.

week 9 **update + collection**

table-non-table

Please **update** us!
1. What is the location of the table-non-table?
2. Is it plugged in?
3. Any new interactions or engagements?
4. Do the rats interact with it in the bedroom?

Sketch a collection
Re-design 2 of your everyday things so they go with the table-non-table in some way. For instance, by transfering a specific design aspect of the table-non-table. Please sketch it!

Everyday Design Studio

to post on Facebook:
Hi Amy and Tom,
So sorry for the late message, I have been pretty sick for a full week. I want to share with you the last priming card below. If there are there any new images you can share to update us, or if there is anything else to report, we are curious to hear!
We plan to discuss the collection at the final interview, but if you manage to post it before, that would be great.
Would you two have time for the final interview on Wed Jun 28 or Thu Jun 29 around 6.30pm?

2. SHARING WEEK 4 FOCUS

WEEK 4 FOCUS: [still] Living with the table-non-table and its Effects

Reflection Pointers
· If you think about your identity as a designer, has the table-non-table changed the way you think about design, yourself as a designer?
· If you think about the 'mood' the table-non-table has been creating in the home, how could you describe this 'mood'

Design Exercise: **Exaggerating Effects of the table-non-table**
Take an effect/impact/influence the table-non-table has on you and exaggerate it as a design concept.
OR: New design exercise? w3. How could your room be altered to sustain/fit the mood of the TNT?
OR What would an [office/bedroom] version of the TNT be?

Keep using week 3 focus. Maybe adding a few questions.

Has having the table-non-table in your home changed any of the following:

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- *the way you perceive things in your home/outside?*
- *the way you do things at home/outside?*
- *the way you understand things*
- *have you brought any thoughts about the table-non-table outside of your home life into you activities outside the home? Like, Did you 'see things' differently in any way and reflected on this in any way?*
-

2. SHARING WEEK 5 FOCUS

WEEK 5 FOCUS: *Engaging with the table-non-table*
We would like you to focus on engaging more with the table-non-table.

Reflection Pointers
Throughout the week, ask yourself the following questions and if possible report on the Messenger group.

· Do you think you alter your activities around the TNT at all?
· When thinking about the ways the table-non-table has been affecting what you think & do, do you in any way regulate that?

Design Exercise: **Remote Control**
Design a remote control for the table-non-table.
OR:
Design Exercise: **Augmentation**
Augment the TNT to enable 'something that is up to you'

3. SHARING WEEK 6 FOCUS

WEEK 6 FOCUS: ...
We would like you to focus on ...

Reflection Pointers
· ...

Design Exercise: **...**
...

4. Schedule final interview

PART V – FINAL INTERVIEW - TNT Amy & Tom

How have things been? It's been changing locations.
What are all the locations it has been? Why has it changed?

A short intro to what we are doing: why we made the TNT and what we want to get from this deployment
Initial purpose
One bigger idea is actually to try to get away from User-Centered Design and to look at what might be different strategies for designing technologies that are operating in people's everyday lives.

- *Attachment*. E.g., we're asking questions like: how could technology have a longer-term place in everyday life? Because one of the shortcomings of today's technology is that it only operates in a short-term place and we only create short-term attachments to them. → E.g. Cellphone. We only hold on to them because of their functionality.
- *Fit*. Their materials are not fitting into our homes, things like that don't fit too well with other things we have in our lives.etc
  So, we're asking: what would be a different approach to technology that could have a longer-term place in everyday life? What could be forms that better relate to other things, what other kinds of materials fit with or in a home better, etc.

Critic might say: so just about finding better fitting materials?

- *Post-functional.* Interactions that don't revolve around functions.

Current deployment

- *Agency*. Things influence us. How do we deal with that?
  Some designers try to design these influences, but that bordres on manipulation. How can users be invited to deal with the influence themselves?

- *Material Speculation*. We're not necessarily looking for an answer per se, but more for discussion points for these kinds of big questions. So, through making this artefact (and others), we're sort of re-imagining what technology is, and we're trying to contrast today's technology. The artefacts operate in a new kind of design space! (there would be no point in just making a normal table for us)
  … and then we bring them into everyday life context with people like yourselves. And we don't make these things to evaluate them as products but they're made as experiments. And by people living with them, having experiences with them, we can have deeper discussions about them, their design spaces.

>>> 3 topics to briefly discuss, and then a few sketches <<<
1. Making sense of a new artefact in one's life
We make sense of things by investigating and understanding how we relate to them. This happens in many different ways.
→ Over time, How did you try to make sense of the TNT?
→ How did you investigate how you relate to it?
> *(Initial curiosity; Tom standing on it; The rats playing with it; location changes of TNT)*

2. Relations with the TNT
There are different ways we relate to things in our lives and I want to talk a bit more about that. So, the TNT, given it's name, is somewhat designed to be relatable to a table. Table's are usually in the background. Even when we use them. Eating … table goes unnoticed, we don't pay much attention to it.   How about the the TNT?
→ When is it in the background? (what situations, what's going on)
Does the TNT ever go unnoticed by you, i.e. do you sometimes feel like subconsciously you know it is there, but you don't consciously think off it. As if it was merged into the background?

> Seems obvious that they'll answer 'mostly in background'? And next question: movement > foreground
> the more interesting question would be if the TNT actually ever succeeds to blend in
> Which is maybe easier to observe then to ask.

→ When does it come into the foreground and is noticed (breakdown)?
(The moments when it moves? What did you guys experience?
When and how did it move between background and foreground when it was unplugged?

3. What occupies their background?

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we're getting used to things, our immediate environment gets textured by all background relations. → What makes up their background? (their technological texturing)

talk about the **things in your background** and the **similarities and differences** of the TNT to these (despite the fact that it doesn't have a directly observable function for you).
Task-oriented appliances: Fridge, washing machine, waffle iron, toaster, (all call for task-oriented intervention like programming etc).   → What about their heating and cooling?, furniture, plants
Non-task-oriented: water, water heating, ?heating & cooling, the broken typewriter, art, plants

Separate theme:
Non-functionality/purposelessness**:** Decorative objects like the typewriter (**fit**)

Anatomy Sketch   Create an Anatomy Sketch of relatable and unrelatable aspects of the TNT
Create a Collection How would you re-design 1-2 things in your home so they in some way 'go with' the TNT.
Redesign How would you change the design of the TNT? What kind of functionality would they add and how?

Co-speculation
- Moderation: how you deal with the *influence* of things
  Think Hue, aura, type writer, putting TNT away ...
- [Metamediation]: how to design for this?
  Recall: technology invites to 'overdesign'