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ARTICLE COMMENTARY



Decentering Through Design: Bridging Posthuman Theory with More-than-Human Design Practices

Iohanna Nicenboim ^a, Doenja Oogjes^b, Heidi Biggs^c, and Seowoo Nam^a

^aHuman Centered Design, Delft University of Technology, Delft, The Netherlands; ^bIndustrial Design, Future Everyday, Eindhoven University of Technology, Eindhoven, The Netherlands; ^cInformation Sciences and Technology, Penn State College of Information Sciences and Technology, University Park, USA

ABSTRACT

While decentering the human has been a key approach in posthumanist HCI, there are still questions and tensions around it. To address them, we outline emergent notions of decentering, tracing it back from HCI to critical posthumanism and connecting epistemological developments in the humanities to design scholarship. Then, reviewing how decentering is understood and practiced in HCI, we distill five emerging dimensions for articulating more-than-human practices. We conclude by unpacking “decentering through design” as an ongoing material practice through which more-than-human designers not only materialize (apply) posthuman theory but also “make” posthuman knowledge in their own unique ways.

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1. Introduction

Amid escalating environmental and social instability, the intricate entanglements between humans and nonhumans are becoming more evident (Tironi et al. 2024). In response to this, designers and researchers working within the posthuman turn in Human-Computer Interaction (HCI) have been developing innovative approaches. These approaches shift the focus away from traditional concerns with users and products, turning instead toward ecologies and relations (Yoo et al., 2023). As part of this shift, they have introduced specific concepts, methods, and practices aimed at decentering the human (Di Salvo & Jonathan, 2012; Forlano, 2016; Smith et al., 2017). Notable techniques for this include, for example, conducting ethnography with nonhumans (Giaccardi et al., 2016; Murray-Rust et al., 2019), practicing “noticing differently” (Biggs et al., 2021; Liu et al. 2019), and designing speculations (Coulton & Lindley, 2019; Helms et al., 2021; Nicenboim et al., 2018; Oogjes & Wakkary, 2022).

Despite the abundance of concepts and methods in posthuman HCI, the practical enactment of these ideas in concrete design work remains an area in need of further exploration (Coskun et al., 2022). To explore that space, we trace key theoretical and epistemological orientations in posthuman thought into actual design practices. We use the concept of “decentering the human” as a focal point for our investigation, articulating what we, designers in HCI, mean when we talk about decentering.

CONTACT Iohanna Nicenboim  i.nicenboim@tudelft.nl  Human Centered Design, Delft University of Technology, Delft, The Netherlands

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1.1. *The notion of decentering in HCI and design*

Over the past decade, the concept of decentering has become integral to nonanthropocentric, more-than-human, and posthuman design discourse. Di Salvo and Lukens (2012) initially defined decentering as “an experiential component of nonanthropocentrism,” where individuals “encounter how nonhuman qualities and forces shape knowledge and action” (p.432–433). Subsequently, Grusin (2015) characterized the “nonhuman turn” as a shift focused on “decentering the human in favor of a turn toward and concern for the nonhuman” (p.3). Further contributing to the discussion, Forlano (2016) argued that “purposefully decentering the human (often conceived of as a discrete individual subject) and embracing multiple and nuanced forms of hybridity offer a way of enabling designers to think and act more critically about their responsibility to design more ethical ways of living and working” (p.43).

In both the humanities and social sciences, decentering is generally understood as a critical perspective and methodological tool that contests dominant viewpoints, theories, and narratives. This involves a move away from mainstream perspectives to recognize and prioritize multiple voices, especially those traditionally marginalized or excluded. In HCI and design, this concept has been adapted to challenge the human-centric focus of traditional HCI approaches. It promotes the inclusion of nonhuman agency in design processes. Specifically, decentering provides a “way of looking at the world in which both humans and nonhumans participate” (Giaccardi, 2020, p. 124), allowing nonhumans to share “center stage” with humans (Wakkary, 2020, p. 117).

While the notion of decentering is commonly utilized in posthumanist HCI, designers and researchers have employed the concept in related yet distinct ways. There is often ambiguity regarding what is precisely intended when employing that term, i.e., what/who is being decentered, what/who is accounted for (centered), and in what theoretical perspectives is the notion of decentering grounded. Trying to understand decentering, on our own and through exchanges with colleagues, has raised questions such as: Does decentering require adopting nonhuman perspectives? If so, how do we cope with the impossibility of accessing nonhuman perspectives really, given our inherent human assumptions and ways of knowing? How can designers know when they have decentered their perspectives enough? Does decentering mean caring less for our species? Can decentering the human be dangerous?

These questions, coupled with others found in existing literature (which we will unpack in the following sections), reveal specific tensions surrounding the concept of decentering in HCI. One such tension, which often arises when designers and HCI scholars first engage with posthuman frameworks, is a misunderstanding that more-than-human design aims to exclude humans altogether. Clarifying this tension is critical, because while decentering within HCI moves away from conventional user-centered approaches, it does not aim to eliminate human perspectives or values. Instead, the objective is to recontextualize human actions within broader temporal and geographical networks (Giaccardi & Redström, 2020; Ron, 2021), as Smith (2019) have clearly articulated:

“By decentering humans from design, I do not mean removing humans from the design process, or from the goals of design, but rather opening up design to include nonhumans and their lifeworlds, as well as our own, in design theory and practice” (N. E. Smith, 2019, p. 12)

Other tensions are more specific to the practices of decentering. For example, there is the impossibility of fully escaping human-centered framings (Livio & Devendorf, 2022; Oogjes & Wakkary, 2022), as well as the emergence of uncomfortable feelings that are associated with decentering practices (Biggs et al., 2021). Moreover, scholars in HCI have unpacked tensions related to representation and labor in posthuman design practices and argued that is time to pay attention to how subjects and objects are produced and to how that shapes the relations between humans and nonhumans (Key et al., 2022).

1.2. *Decentering at the interplay between posthuman theory and practice*

To address the tensions around the notion of decentering and enable HCI researchers and designers to use posthuman approaches confidently, it seems crucial to engage in discussions that expand our understanding of how decentering is enacted in design and research practices in HCI. Since designers and researchers have found their own unique ways to decenter the human, by developing various methods and tactics, we argue that decentering cannot be solely conceptualized theoretically and must also be entangled with the activities, tools, and daily challenges of design processes. Engaging with decentering in the interplay between posthuman theory and practice might have several benefits for HCI researchers and designers. First, contextualizing decentering within theory might help designers and scholars in the posthuman community to be more precise in their commitments and recognize their limitations. That is, for example, to avoid creating similar blind spots as previous traditions, such as unintentionally establishing new, undesirable centers. Conversely, situating decentering within practices might help maintain generative, situated, and pluralistic commitments, which align with the core objectives of posthuman approaches.

To cope with the inherent complexity of connecting across considerable distances between “theory” and “practice,” we organize the article as follows. In the first part (section 2), we perform two moves: first, we contextualize decentering within critical posthuman theory (section 2.1), and then provide an overview of how decentering is understood and practiced in the posthumanist HCI community, by examining literature from HCI and design venues (2.2). Based on those two moves, we formulate five dimensions of decentering: Cornerstone, Crux, Constitution, Context, and Contribution (2.3). These dimensions articulate not only who/what is de/centered, but also what new relationships are formed, and which tactics are used for that.

In the second part of the article (section 3), we position decentering more strongly within practices, by unpacking our practices through the dimensions of decentering. Looking across our practices, we highlight emergent aspects of how we enact decentering, such as embracing the frictions in the material encounters with nonhumans and staying uncomfortable by constantly moving to different knowledge domains. Our aim with this is not only to probe how the dimensions could be useful in explaining what we mean when we talk about decentering, but also how they could be generative. Based on that, in section 4 we explore emergent notions of decentering and conceptualize “decentering through design” with the themes of movement and materiality. We conclude (section 5) by contextualizing the article’s insights within the posthuman turn more broadly, responding to Braidotti’s invitation to “materialize posthuman theory.” We ask whether decentering could be an example of how designers have materialized and also “made” posthuman knowledge through design.

While this paper engages with theory and literature, it does not aim to establish a static definition of decentering or to comprehensively cover all its possible applications. Rather, the goal is to offer designers and researchers in HCI a framework that can assist in articulating their practices clearly, while also accommodating multiple perspectives and new epistemological stances.

2. *Decentering the human in design and HCI*

Posthumanist HCI encompasses a broad variety of different perspectives – science and technology studies (STS), object-oriented ontology (OOO), postphenomenology, new materialism, and agential realism, among others (for an overview of these perspectives see Di Salvo and Lukens, 2012; Forlano, 2017; Frauenberger, 2019; Ron, 2021). These perspectives have played an important role in grounding the proposals of designers and researchers in HCI to decenter the human. Especially, they have been crucial to move beyond the dominantly human-centered design (HCD) approach, which has been useful in surfacing human needs, but has proven to be less useful in understanding how human concerns are entangled with larger ecosystems and nonhuman agencies (Coulton & Galen Lindley, 2019; Forlano, 2017; Giaccardi & Redström, 2020). In this paper, we focus on (and align ourselves

with) the perspective of feminist critical posthumanism (Braidotti, 2013). By rejecting individualism, this perspective brings a new understanding of the subject as a relational and embedded part of a whole, offering a specific and affirmative call to human-decentering practices in HCI (Klumbyte & Claude, 2022).

2.1. *Tracing outwards: decentering in posthuman theory*

Reflecting on the roots of decentering, we trace how the concept of decentering in HCI builds upon the tradition of feminist posthumanities, establishing possible connections with design scholarship. The critical posthumanities is defined by the feminist philosopher and posthuman theorist Rossi Braidotti (2019) as a convergence of two critiques: one that challenges anthropocentrism, and the other that questions the normative (European and humanist) construction of the “human” as man, white, and able. Merging these two critiques, posthumanism questions the traditional division between humans and nonhumans, challenging dualisms such as human/animal, human/machine, as well as life/death, organic/synthetic, and natural/artificial (Ferrando, 2019; Haraway, 2016). In fact, the critique of the human, and the questioning of binaries, are entangled, because the humanist conception of the human was constructed against its opposing others – the ideal man against the naturalized, sexualized, and racialized “others” (Braidotti, 2013). In contrast to prior traditions that challenged the humanist “man” from a rhetorical perspective, posthumanism includes material and nonhuman entanglements, asking how nonhuman others complicate the conceptions of humans – thus moving from a discursive, socio-cultural, and socio-linguistic deconstructive critique, to a material-discursive one (Braidotti, 2013; Grusin, 2015).

As an alternative to the humanist “man,” the critical posthumanities offer a new vision of the human and claim that constructing a posthuman subjectivity that is material and relationally configured, is necessary to meet the complexity of our times. Posthuman subjects are “framed by embodiment, sexuality, affectivity, empathy, and desire as core qualities” (Braidotti, 2013, p. 23). Thus, seen as relationally constructed amidst many material actors and agencies, posthuman subjects are inherently “decentered” in contrast to a centered, individualistic concept of the human.

To decenter the subject, posthumanism has built on philosophical notions of assemblage and multiplicity from the postmodern philosophers Gilles Deleuze and Felix Guattari. Assemblages are described by these authors as “heterogeneous elements that function together” (Deleuze & Parnet, 2007, 2002). Multiplicity is defined as “neither subject nor object, only determinations, magnitudes, and dimensions that cannot increase in number without the multiplicity changing in nature” (Guattari & Deleuze, 1987, p. 9). What is important to note in relation to decentering, is that in contrast to the enlightenment man who was contained and individualistic, the subject seeking posthuman orientations must somehow realize their own multiplicities, their own non-center, their own assembled nature, and role in assemblages (Braidotti, 2013).

It is also important for the decentered subject to resist binaries, and instead see boundaries as constructed and as always “becoming” in material/linguistic processes. Posthuman theorist and science and technology studies scholar Barad (2007) theorized that boundaries and relations between humans and nonhumans are constantly being created at the intra-action of materials and linguistics via processes/practices. Thus, in contrast to Humanism’s teleologically ordained march toward an “individual and collective perfectibility” (Braidotti, 2013, p. 13), posthumanism views the subject as a constant and non-teleological multiplicity that becomes with or alongside nonhuman lives and agencies.

Reflecting on the roots of decentering has a few implications for design and HCI. One is that it brings more nuances to the critique of HCD by bringing attention to how and when the conception of the user was constructed. Cooper and Bowers (1995) have claimed that the notion of the user was constructed in HCI as a discursive object along with the rhetoric of “progress” and the rhetoric of “crisis.” Giaccardi and Redström (2020) further expanded on this by asserting that not only was the human subjectivity constructed as a neutral user distinct from the designer, but also the ontological

position of objects was defined as tools for humans to use. Homewood et al. (2021) exemplify those shifts by showing how the conception of the body in HCI was influenced by the different constructions of the subject in the waves of HCI (Bødker, 2015). While the criteria of usability and functionality from the first wave addressed the body through ergonomics, the empirical approaches to observation from the second wave addressed the body as an object to be studied and thus ignored subjective accounts.

Another implication of the roots of decentering for design and HCI is the process-oriented idea of *becoming* that underpins much of posthuman theory. It seems helpful for designers to move from decentering as a goal to a practice (Livio & Devendorf, 2022). It can help designers to place emphasis on processes of becoming: to not focus on the “objects” produced (of knowledge, of design) but on the processes that drive their production. While *becomings* are somewhat discussed in posthuman design and HCI literature (Plummer-Fernandez, 2019; Redström & Wiltse, 2018), there are not many accounts of those concepts applied in relation to material ways of making. Moreover, the path (often inwards) toward a posthuman subjectivity is not fully addressed yet. Thus, to decenter, designers might need to shift not only toward nonhumans, but also toward themselves. Taking the notions of becoming and assemblages, that type of decentering (as turning toward more-than-humans and turning toward the self) could be pursued for example by attending to the interstitial boundaries between the humans and the nonhumans, as well as by uncovering complex entanglements to dissolve dualisms. An example of this is the practice of the feminist new materialist anthropologist Anna Tsing. By attending to Matsutake mushroom as a main “character” in her ethnography, she draws together a “polyphonic” account of human and nonhuman intersections (Tsing, 2015). Polyphony, for Tsing, is including and noticing multiple, intertwined voices and timelines: “polyphony is music in which autonomous melodies intertwine” and polyphonic music asks that one listen to, “pick out separate, simultaneous melodies and to listen for the moments of harmony and dissonance they created together” (p. 24). This is inherently a decentered practice.

2.2. Tracing new lines: decentering in more-than-human design practices

To further explore the notion of decentering, we examine its enactment in design and research practices by analyzing a corpus of publications from HCI and design conferences. The corpus was compiled by searching for the terms “decentering,” “decentered,” and “decenter,” accounting for both British and American spellings, in the ACM library and the proceedings of design conferences such as DRS, Pivot, and Nordes. While we did engage with a collection of papers, our work is not a traditional literature review. Specifically, our method was iterative and reflective, aimed not at mapping the existing landscape but at allowing themes and strategies to emerge that could articulate decentering practices in design and HCI. The first iteration (section 2.2.1) identifies thematic clusters, while the second (section 2.2.2) adopts a more analytical stance, adding nuance to these clusters through a series of dimensions.

2.2.1. What is decentered and what is instead accounted for (centered)

The first iteration involved a search in the ACM library, yielding 245 papers. We reviewed the abstracts, keywords, and sentences where the term “decentering” was used, subsequently labeling papers based on themes identified in their abstracts. Initial labels included categories such as understanding, planetary impact, perspective, norm, power, epistemology, and agency. After discussing these labels, we opted to cluster the papers based on the distinct elements they sought to decenter. This led to the identification of five thematic clusters (Multispecies, Perspectives, Agency, Epistemology, and Power). We will further elucidate these clusters, providing selected exemplars and detailing the tactics employed by them to decenter the human.

2.2.1.1. *Multispecies: decentering human privilege and accounting for multi-species.* The work in this cluster problematizes the privilege of humans over other species and supports multispecies cohabitation. It employs methods such as autoethnography, noticing, and attunement. For example, Biggs et al. (2021) decenter the self by using autoethnographic and noticing practices combined with field observation, journaling, and making. Liu et al. (2019) decenter human's ontological privilege by co-creating with nature through decomposition, while Smith et al. (2017) does that by reflecting on cohabitation in urban settings, and Tomico et al. (2023) by exploring the personal experiences of cohabitating with plants using auto-ethnographic tactics.

2.2.1.2. *Perspectives: decentering the designers' perspective and accounting for more-than-human senses.* The work in this cluster problematizes the blind spots of the designer's perception, logic, assumptions, and biases, by accounting for, accessing, or attuning to, nonhuman perspectives through thing-centered ethnographic methods and speculations. For example, Giaccardi et al. (2016) decenter the designers' perspective by collecting and aggregating data ("data worlds") from the perspectives of things. Wakkary et al. (2017) decenter the designers' perspective by inquiring into the gaps between things and humans through thing-centered material speculations. Akmal and Coulton (2020) consider the experiences and the agency of things through making design fictions; Reddy et al. (2021) use interviews and role-play as tactics for exploring how ethics is encountered in human/nonhuman relations. Dörrenbächer et al. (2020) offer an alternative approach to the prevalent anthropomorphism in the physical appearance and behavior of social robots, by creating devices to experience the perspective of robots.

2.2.1.3. *Agency: decentering the human intention and accounting for the vitality of the materials and bodies.* The work in this cluster problematizes the idea that only humans have agentic capacities, and accounts for vibrant materiality through collaborations. For example, Oogjes and Wakkary (2022) decenters the privileged ontological position of the human designer, using noticing, together with translations and landscape ethnography, to open more porous, blurry boundaries with nonhuman things. Devendorf and Ryokai (2015) problematize current practices of 3D printing, decentering the human maker as a visionary and commanders of passive machines and materials, and propose a shift toward more collaborative relations. Stricklin and Nitsche (2020) use co-creating games to explore collaborations with clay. Behzad et al. (2022) investigate how nonhuman artifacts can participate in design through breakage. Nordmoen (2020) investigates material agency in the practices of woodworking, focusing on how craft-makers see materials as collaborators.

2.2.1.4. *Epistemology: Decentering human knowledge and accounting for plural narratives.* The work in this cluster problematizes the traditional position of humans as main producers of knowledge and intention, and accounts for unheard voices, situated knowledges, partnerships, and co-performances. For example, Giaccardi (2018) proposed that things can make things too, moving toward design partnerships with nonhumans: a view in which things, beyond being just collaborators, can help designers access trajectories unattainable to human observation and potentially contesting human's worldview. Kuijer and Giaccardi (2018) propose the notion of co-performance, a view which considers artifacts as capable of learning and performing next to people. French et al. (2020) explore that notions of aesthetics can go beyond humans. Homewood et al. (2021) trace the evolving conceptions of the body across the progressions from 1st to 4th wave HCI.

2.2.1.5. *Power: Decentering the privilege of dominant groups and accounting for the marginalized perspectives.*¹ This cluster, compared to the others, seems to stand a bit apart, in that some of the work included is not explicitly positioned within the posthuman turn in HCI, or similar terms like

²This cluster, compared to the others, seems to stand a bit apart, in that some of the work included is not explicitly positioned within the posthuman turn in HCI, or similar terms like more-than-human or postantropocentric design, but intersects instead with participatory design, social sciences, and advocacy.

more-than-human or postanthropocentric design, but intersects instead with participatory design, social sciences, and advocacy

The work in this cluster problematizes the status quo and empowers people by proposing interventions, provocations, participation, and adversarial tactics. For example, Tironi et al. (2023) invite nonhumans in prototyping to open up cosmopolitics against anthropo-normative consensus in design practices. Tran O’Leary et al. (2019) suggest that conventional design practices maintained by a design elite may perpetuate forms of institutional racism; Harrington et al. (2019) question the designers’ power, deconstructing community-based collaborative design, proposing a move toward more equitable participatory design engagements. Forlano (2023) explores agency, labor, and failure, using examples from disability activism, art, and design to challenge prevailing sociotechnical perspectives on technology, thereby suggesting alternative futures for more inclusive human-machine coexistence.

2.2.2. Five dimensions of decentering

Our initial clustering of the themes helped us to grasp a possible landscape of decentering practices. The question “what is decentered and what is instead accounted for” made the concept of decentering clearer. The goal of our initial review was to find language and tools to look at decentering practices (including our own) in a new light. However, when we tried to apply the thematic clusters to the literature from design conferences,² the clusters seem to lack nuance. We also found the themes somewhat porous – design exemplars could fit in multiple themes. We saw these aspects as an opportunity to develop the framework further by adding dimensions that can explain more about the way designers decentered the human in their practices (Figure 1).

After a series of iterations, we arrived at five dimensions, which we unpack in what follows, together with a few examples of how they could be used to articulate more-than-human practices.

- *Cornerstone*: This dimension focuses on the theoretical foundations of the inquiry, such as feminist technoscience, new materialism, and object-oriented ontology.
- *Crux*: This dimension examines what is being problematized, such as technological determinism, anthropocentrism, or colonialism.
- *Constitution*: This dimension examines the relationships between the center and the decentered, as well as possible strategies used to address what is not in the center.
- *Contribution*: This dimension examines the specific methods, concepts, strategies, etc. that the paper contributes to HCI or design.
- *Context*: This dimension looks at the specific design or HCI community for the contribution.

Using these dimensions to reflect on the papers from the corpus allowed us to articulate more nuances and differences in decentering practices in design. For example, projects in the *context* of technology seemed to problematize (*crux*) anthropocentric understandings of responsibility and challenge technological determinism. They seemed to build more on *cornerstones* such as new materialism, object-oriented ontology, phenomenology, and feminist technoscience. For example, Devendorf et al. (2016), decenter the maker by taking post-anthropocentric perspectives in the context of 3D printing. Having new materialism as a *cornerstone*, the authors challenge the human maker as a visionary and commander that acts upon passive machines and materials (*crux*). Furthermore, they problematize how the current design of a 3D printer propels a particular set of values in making, such as accurate replication, while constraining others like close interactions with materials. By exploring vibrant cooperations between human designers and nonhuman materials, they *constitute* partnerships between makers and 3D printers and thereby *contribute* to the post-

²We used the exact search keywords for ACM to search in the proceedings of Nordes 2021, Pivot 2021, and DRS 2022.

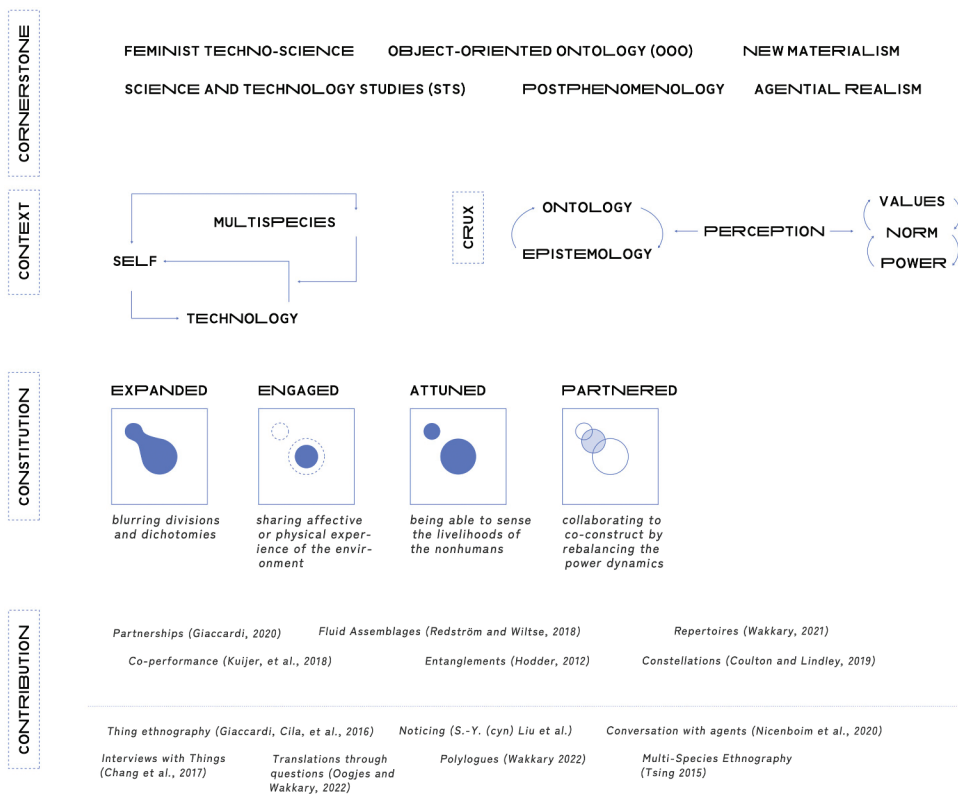


Figure 1. A document we produced while conceiving five dimensions for decentering (cornerstone, crux, constitution, context, and contribution) by reviewing literature from HCI and design venues.

anthropocentric digital fabrication perspective, by proposing a more reflective mode of making in which humans and nonhumans are placed on even footing.

Conversely, we saw that some projects in the *context* of multi-species and environmental design problematized human exceptionalism (*crux*) by acknowledging that human life was dependent and entangled upon the health of other species. Moving toward kinship and companionship, these projects aimed to form relations of cohabitation by using methods to attune to nonhumans such as noticing and designing-with (*constitution*). For example, Liu et al. (2018) re-envision human-fungi relationships (*constitution*) in the *context* of a mushroom foray. The underlying *cornerstones* of this research are posthumanist discourses such as Anna Tsing’s (2015) collaborative survival and Donna Haraway’s (2016) calls to stay with the trouble. Having human perception as a *crux*, they seek ways to raise our ability to notice, respond, and become-with the livelihoods of other species. By proposing three different prototypes to support noticing fungi (*contribution*), they *constitute* alternative relationships between humans and fungi: expanded, engaged, and attuned.

While the dimensions certainly provided a higher level of synthesis to the thematic clusters (section 2.2.1), we felt that, as designers, using the dimensions to unpack our own practices was a crucial step. Ultimately, as early career researchers, coming from different corners of the posthuman turn in HCI, what has brought us together was the urge to find the overlaps and particularities between why and how we decenter the human in our design and research practices. Therefore, our next step involved articulating our practices of decentering using these dimensions. This not only facilitated our exploration of how these dimensions could elucidate more-than-human practices but also enhanced our understanding of how they could

offer fresh perspectives on our work, potentially revealing emergent directions and notions of decentering.

3. Decentering as enacted in our design research practices

While the previous sections provided an overview of where decentering comes from and how it has been developed within HCI at the intersection of theory and practice, this section positions decentering more strongly within design practices. We do that by using the five dimensions (*Cornerstone*, *Crux*, *Constitution*, *Context*, and *Contribution*) that we distilled from the literature (section 3), to reflect on our own design research work. By doing that, we bring concrete examples of how we have dealt with some of the questions that were presented throughout the article.

To unpack our practices with the dimensions, each of the first three authors (Iohanna, Doenja, and Heidi) wrote a series of personal reflections. Prior to that, as a sensitizing exercise, we followed a process inspired by trio-ethnography (Howell et al., 2021). In what follows, we present insights about decentering gained from comparing and synthesizing our personal reflections.³ By doing that, we also explore the synergies between some of the dimensions, namely, *Context* and *Crux*, and *Contribution* and *Constitution*.

3.1. Using the dimensions to reflect across our practices

Although our *Cornerstones* (the theoretical foundations of our inquiries) have overlaps, ranging from object-oriented ontology, eco-philosophy, new materialism, feminist techno-science, and post-phenomenology, they are distinct in the way we have engaged with them. That is, in which order we encountered the different perspectives and what design projects we produced when we engaged with them.

IOHANNA: “While my latest work has as a cornerstone new materialism, my first engagement with posthumanism was through the perspective of object-oriented-ontology [...] thinking of temporal and geographical scales that were larger than me, decentered me so much, that I couldn’t go back to doing design as usual. At that time, I tried to provoke other people to question human exceptionalism, by doing speculative design projects that unsettled the traditional relations of humans and designed artifacts. Later, when reading new materialism, especially Bennet’s eco-philosophy, I could position those projects more clearly in relation to political dimensions. Bennet’s notion about vital materiality also inspired me to move to a more nuanced understanding of agency. That notion of agency as decentered and emergent in configurations, led me to better engage with the notion of correspondences from Ingold (2017) and to think of the entanglements of humans and nonhumans, which was the focus of the project called “Everyday Entanglements of a Connected Home” (Nicenboim et al., 2018), as it is shown in Figure 2.

DOENJA: “I am interested in messy, idiosyncratic, mysterious, indirect, accidental, surprising, and overlooked ways designed things mediate and shape the world. In everyday life, it is not hard to see how things can escape from our understanding or control: socks, Tupperware lids, bobby pins, and pens inevitably get lost; headphones get tangled in our pockets. In design practice, we understand this too. Prototypes stop working right when you are about to give a demonstration, things break or get lost in the mail, and models don’t translate neatly to actuality (see Figure 3). What would happen if designers would actively listen to, and work with such material manifestations? How

³To preserve the personal voice of each author, we include excerpts from our personal reflections as quotes.



Figure 2. The project “Everyday Entanglements of a Connected Home” by Iohanna Nicenboim, is a design fiction project exploring the tensions of living with smart devices and predictive technologies.



Figure 3. Part of an inventory of ambiguous belongings by Doenja Oogjes: things that are in limbo are not kept and cherished as meaningful, useful possessions, but are not discarded either. The belongings pictured are categorized as fractured functionality, and all have a missing counterpart (for e.g., one glove, one sock and one earring).

to engage with things we can’t explain? I arrived at more-than-human thinking and relational philosophies on my journey to better understand such entangled, complex, and indirect relations that are already present in design practice. [...] Reflecting on the cornerstones of my practice, my interest in more-than-human thinking originated in post-phenomenology, feminist techno-science and new materialism. I was also working closely with Ron Wakkary’s concept of *designing-with* (Wakkary 2021). What I drew from these theories was the joy to be found in blurry boundaries, the agentic capacities of nonhumans and the many possible simultaneous relations of which we only can access a few”.

HEIDI: “My cornerstones are posthuman theories that relate to climate change and ecological thinking, design theory around agency of artifacts and posthuman methodologies, and some critiques of those theories [...] I became more interested in the theoretical side of climate change, through asking what the ‘ontological’ roots of unsustainable actions and systems were. This line of questioning brought me toward decentering practices in a more conscious way as I began to ask what kind of design practice would allow me to have different types of relations with more-than-human others. Following the arguments of design philosophers like Donna Haraway (2016) and Anna Tsing (2015), as well as provocations from the HCI and design communities, I explored noticing as a method for decentering. The first example of this was my project where I used my

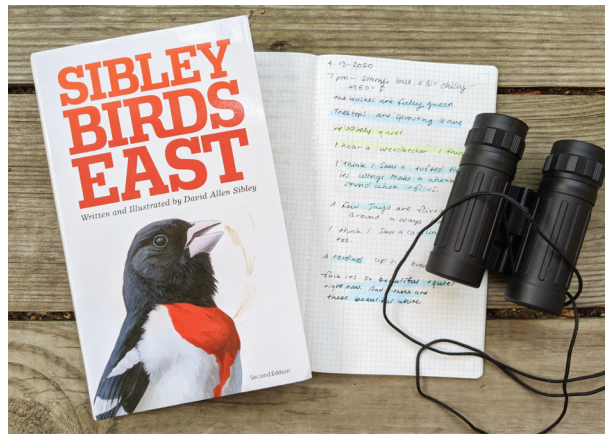


Figure 4. A photo of Heidi Biggs' birdwatching notes and tools (Biggs et. al., 2021)

own bird-watching practice attend differently to birds in my neighborhood and examine how I could decenter myself in relation to the local ecology around my new home in Indiana, where I just moved. [...] In this project, which is shown in [Figure 4](#), noticing allowed me to track normative orientations to nonhumans, as well as experiencing the possibility of orienting differently to nonhumans through attending to nonhuman actors more often and more carefully. In this project, the cornerstone was ecological posthuman theory which also addresses climate change and building relations to nonhuman others like animals and ecologies.”

The *Contexts* of our work have overlaps but they are also distinct: Iohanna has worked within the areas of connected devices and artificial intelligence, Doenja within everyday things and textiles, and Heidi within sustainable HCI and critical computing. Reflecting on the differences between contributing to those fields, and what needs to or could be problematized in them, we noticed that our *Crux* (what is being problematized) seems to have differences related to our fields: Iohanna problematizes technological determinism, Doenja the relations of humans and designers with materials and Heidi the relations of humans with the natural world.

IOHANNA: “I love taking things apart and putting them back together. My work has often focused on exposing tensions, failures, and misunderstandings. By provoking a revision of the hidden assumptions and traditional roles of the user/artifact/developer, failures reveal the positionality of the designer and the technological agents and challenge the traditional ways of understanding users as just that, users. [...] As a crux, I try to problematize technological determinism by exposing that there are many humans involved in the development of AI systems; and anthropocentrism, by aiming to design interactions with AI that are not only centered on human voices but listen and respond to more-than-humans. For example, I have problematized the design of voice interactions by exploring how they follow an anthropocentric paradigm when they only listen to human voices [...] By taking a posthuman design orientation, I moved away from assuming that users are neutral and instead tried to account for the positionality of people and how differently situated understandings of AI might be configured in everyday situations (Nicenboim et al., 2022) [...] Haraway’s (2016) notion of situated knowledge(s) has supported my practice, as I problematized values for designing AI

responsibly, specifically transparency and Explainability. I decentered the perspectives of the ones developing the systems, and accounted for the perspectives of other people that are not direct users of AI.”

DOENJA: “The context of my work is broadly on materials and tools of design, with a more recent focus on textile fabrication. I wanted to understand how the more-than-human already engaged design practice and how this could be more prominent. Directly or indirectly, many nonhumans are involved in the design and continued use of technologies: infrastructure of 4 G networks running through soil and oceans, material resources traced back to their origins of conflict minerals, animals, or plants. To engage in a concrete example, my practice turned to textile fabrication. Textiles are interesting for this investigation as they are material composites of which the labor, resources, and relations are relatively traceable. [...] I experienced many decentering moments in my textile practice. For example, while weaving, my experience of time shifted from a human-centered conceptualization to one that was led by the materials and machines I was working with. Suddenly, I was going through the day with notions as knots-per-hour and pixels-per-minute to understand time. [...] Through design, I was trying to problematize (crux) the dominant instrumental relations with technologies that are often the center of investigations in HCI studies.”

HEIDI: “My research is, and has always been, tied to issues of environmental sustainability [...] The context I work within is of course a cross of sustainable scholars in HCI as well as posthuman scholars in HCI [...] My crux is often how to pull greater focus to nonhuman actors and the phenomenon of climate change in local, place-based ways, asking what is at stake and what changes when we attend to nonhumans in ways that pull them from the background to foreground. And recently, my crux asks what posthumanism allows us to see, and what might be missing, in response to critiques.”

Our *Contributions* to the different fields mentioned above vary, from design exemplars to methods and ways of knowing, to reframing, untangling, and rebuilding design. As *Constitutions*, the relationships we aim to form with what/who we account for when we decenter, have also unique nuances.

IOHANNA: “The concrete contributions my work has made to HCI or design I would say are exemplars, methods, and tactics. I have developed a method called Conversations with Agents, which I used to expose existing relations and enact different and more situated ones (Nicenboim et al., 2022) [...] Generally, I am less interested in methods and more interested in tactics because I think posthuman design cannot be just documented in a template instead, it needs sensitizing concepts and experiences. Tactics like enactments have helped me to reflect on my positionality, and expose the positionality of intelligent agents [...] as constitution, one of the new relations that I hope can be formed is decolonial [...] as perceiving and attending to the alternative voices silenced (see Figure 5).”

DOENJA: “My contributions include design examples and experimentation in design narratives. While much work is underway in more-than-human thinking and design, I found that much was accounted for from the human perspective, and rarely were machines, tools, and materials of design itself considered as nonhumans [...] In reflecting on the constitution, and the relationships between the center and the decentered, in my practice I attempt to make space for nonhumans of design itself and find ways to more actively engage with them. While designers are always in dialogue with materials, the human voice and intent are often more dominant and rarely do we listen deeply or follow what is being expressed. As such, my work is a continuous exercise in decentering myself as



Figure 5. Performance art developed by Iohanna Nicenboim, within a multidisciplinary artistic collaboration, to explore decolonial ways of listening, performed by six human artists and three smart speakers (Nicenboim et.al., 2023).

the human designer, knowing when to pause or step back, and critically reflecting on which human-centric assumptions I could unintentionally be re-enacting. This became very clear in the ‘Morse Things’ project (Oogjes et al., 2020; Wakkary et al., 2017), an ongoing project of the Everyday Design Studio investigating what it is like for a thing to be on the internet. The project consists of ceramic cups and bowls that communicate with each other over the internet and Twitter. The shift of thinking to thing-centeredness proved to be extremely fragile (literally). In preparing for a deployment study, our team chose to focus on particular aspects of the project, such as machine learning language and battery life, overlooking the quite obvious fragility of the ceramics itself. Yet the physical breaking of the cups also revealed to us the existing relations that we had initially overseen [...] Ultimately, this project allowed me to shift from focusing on shiny outcomes of design projects to understanding events and encounters as more fruitful possibilities of listening to nonhumans of design (see Figure 6).”

HEIDI: “I have contributed methods like bird watching as noticing, duoethnographic map making, and expanded how we think of sustainability and posthumanism in SHCI by introducing abjection and cross-disciplinary discourse [...] One of my first questions around sustainability asked why digital objects are so discardable and anonymous-feeling. This question led me to apply to a Long(er)-Term Design Thinking Workshop⁴ that asked questions about longer-term thinking in design at a tender stage in my research (right before my master’s thesis). Shortly after the workshop, during the summer between the two years of my masters, my city (Seattle, WA) experienced yet another ‘smoke’ season – where smoke from forest fires clouds the air for a month at a time every summer. As I bike commuted to work in the smoke, and felt its toll

⁴The workshop was organized by Batya Friedman, Will Odom, and Daisy Yoo in 2018 <https://hcd.icat.vt.edu/news/workshop-on-long-er-term-design-thinking.html>



Figure 6. The kintsugi cup from the “Morse things” project by Doenja Oogjes and the everyday design Studio that broke, was repaired, and broke again (Oogjes et al., 2020).



Figure 7. A close-up of Heidi Biggs's project “the high water plants” Biggs Heidi and Desjardins (2020) that make climate change data tangible through a mechatronic pair of pants that ‘rise up’ when a cyclist enters an geofenced area where they might experience sea level rise in the future.

on my lungs, I began to wonder if it was related to climate change and ended up doing my master's thesis project on futures of climate change for everyday cyclists (see Figure 7) The research asked how climate change data – which is so very abstract, could be made tangible and situated in places and everyday practices. But not only that, how climate change will impact people in the same geography differently, and how presents are entangled in futures. Inspired by design concepts like ‘unaware objects’ such as the table-non-table, which had a sense of agency and autonomy, my research explored making a wearable artifact that offered somewhat self-guided experiences outside of utility. And secondarily, this research explored the object-oriented ontology's concept of hyperobjects, coined by Timothy Morton, which is a massive and distributed ‘object’ (like climate change) that operates in complex ways (Morton, 2013). I argued my

design artifact made the hyperobject of climate change more tangible and pinned it down in relation to everyday places and practices. [...] The *constitution* of my work shifts awareness to nonhuman timelines, nonhuman actors (like birds) and my own assumptions about what sustainability and the impacts of climate change will be moving into the future along lines of race, class, and gender, seeking a more intersectional sustainability agendas that find intersection with more-than-human actors as well.”

3.2. Emergent aspects of decentering in our practices

It is interesting to notice that the decentering we describe in our work is often one in which we turn in. Often, that process is filled with discomfort, which is experienced by us in different ways, but generally involves exposing frictions, moving to new domains, and staying a beginner.

IOHANNA: “Although I aim to decenter the position of the user to design more inclusively, I also try to decenter (defamiliarize) myself and my process by trying to enact different perspectives. For example, when researching voice assistants, together with a design team, we expanded the sites of research by looking for knowledge on nonhuman epistemologies in different languages spoken by some team members (Spanish, Indi, Norwegian, and Russian) and sharing it with the group. Also in the ethnography, when discussing childish ways of looking at the world, I did an activity with my five-year-old son, in which we designed together elements to collect water drops with local materials while discussing what he thought the drop perspective might be like (to what my kid said: “the world is a slide”). I also try to decenter my process by engaging with relatively unconventional formats (podcasts, performances, workshops, media art) and materials (living organisms, sound, intelligent agents), as well as by reflecting on the agency of the materials and prototypes. In making Conversation Starter (Nicenboim et al., 2023), for example, the physical artifacts became present to me as agents in the process, when the prototypes started to develop mold and a strong smell while being exhibited (see Figure 8).”

DOENJA: “The challenge then becomes not only a matter of decentering the human and counter-ing human-centered narratives but also a more introspective one, involving the decentering of the human designer, and overcoming deeply ingrained human-centeredness in the practice of design and the way we present and talk about the things we make. [...] I saw potential in a material dialogue between theories and approaches from outside of HCI Through this, creative writing and first-person experiences became part of my practice: I described nonhumans that were present and took time to give them a voice in my stories. I took on a humbler role, and paid attention to fragility, temporality and mediations [...]. I also tried to connect with nonhumans such as the flax or the sheep that the yarn I was working with was made from, even if neither sheep nor plant were in the room with me. For example, I did a silly test to see what kind of sheep I was (playing with the blurry boundaries and unavailability of anthropomorphism) and made an illustration of threads getting tangled. [...] In more recent work, I worked on a project for an indigenous weaver in which I supported her process of weaving on a TC2 jacquard loom (Oogjes & Wakkary, 2022). It provided me with a different perspective on failures, interruptions, and material resistance. In our collaboration, we encountered friction in translating her notations for working on a jacquard loom. I was initially not flustered by this and had come to recognize it instead as an opening to listen to material agency like with the Morse Things cup, and the knots in the yarn. Yet her perspective acknowledged



Figure 8. Mold growing in Iohanna Nicenboim's interactive prototypes for the project *Conversation starters* (Nicenboim et al., 2023).

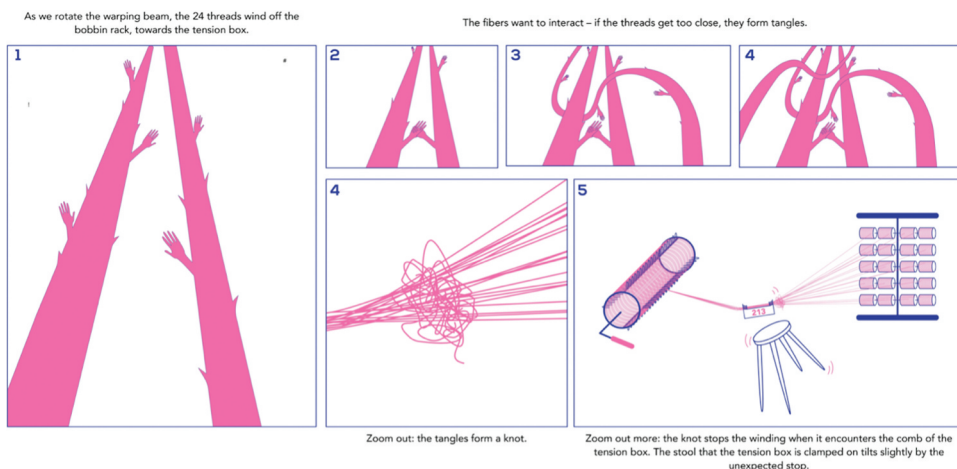


Figure 9. An illustrated fabulation of how Doenja Oogjes pictured threads getting tangled in her weaving practice. This led to a reflection about the inevitability of understanding through human ways and a choice to instead give in and see how to utilize silliness (Oogjes & Wakkary, 2022).

that this is essentially opportunistic. In this context of working with century-old techniques, the approach of considering failure and fragility does not give enough credit to ancestor's embedded knowledge in existing techniques (see Figure 9)."

HEIDI: "Throughout the course of the bird watching project (Biggs et al., 2021), I noticed that bird watching was less straightforward or comfortable than I expected. As soon as I started pulling a focus on birds, or bringing what was in the background to the foreground, my field of experience shifted. The shift was not completely comfortable, in fact, it was strange, and at times overwhelming. Drawing on this insight, I used the concept of abjection,

developed by theorist Julia Kristeva to shift how I saw birds as not ‘other,’ but ecologically abject. Abjection explores parts of the self that one rejects to constitute self-boundaries, often by visceral discomfort. However, framing birds as abject allowed birds to be conceived of as a part of myself, more broadly, which I had learned to push to the margins. Moving forward, I am interested in the difficult moments in decentering, or moments of friction, as well as what comes on the other side of moving through these frictions. Therefore, I found myself having questions about the discomfort of decentering, or the awkwardness of the practice.”

Making mistakes and embracing the “silliness” of interactions with nonhumans aided us in decentering ourselves. This shift allowed us to move away from an expert stance to a more humble position, akin to that of a beginner. As articulated by Doenja, the pertinent question is not how to “be” but how to “stay” a beginner. Similarly, consistently encountering or even intentionally creating friction in our designs seemed to be a common strategy we used for decentering the human. By exposing frictions, we challenged the notion of humans as neutral and fostered the configuration of new relations.

While discomfort might be anchored in different motivations in our practices, encountering it through the materiality of design, affords us opportunities to decenter ourselves, i.e., to challenge our role and provide us a new perspective. That suggests that discomfort, beyond being related to the practice of Design Research more generally, becomes a part of decentering practices when it involves problematizing the designers’ power and their ontological privilege. Reflecting on decentering as understood in posthuman theory (section 3) in the need to construct the posthuman subject, uncomfortable moments for all of us seem to be when we notice our own posthuman subjectivity.

3.3. *Lifting the questions about decentering*

Using the dimensions to facilitate the process of reflection across our practices gave us new language to talk across our projects and revealed some similarities and differences between how we approached decentering. Mostly, it showed how some of the questions we had about decentering (which we articulated in the introduction) were situated within the contexts in which our practices of decentering were enacted. Our practices provided illustrations of how we have grappled with these questions in our own design research practices in a material way. Who/what we decenter, the strategies used to account for new perspectives, and the relationships formed with them were distinct for each practice. For instance, Iohanna aimed to decenter the figure of the user as neutral in the design of AI and account for more-than-human voices, Doenja focused on decentering the designer to account for material agency, and Heidi sought to decenter the self in favor of nonhuman environmental sustainability. Secondly, it appears that different contexts yielded various understandings of concepts and terms that influenced our design practices, as well as problematized different relations.

Instead of measuring if we have decentered enough, our practices suggest that instead of relying on a specific metric, recognizing our own positionalities and limitations in achieving complete decentering is vital. Moreover, a key aspect of our practices that could be productive in addressing the tensions around the impossibility of decentering completely, is the understanding of decentering as an ongoing process. The last point is exemplified in the following reflections:

IOHANNA: “For me, decentering is a practice (always a failed attempt) of enacting more-than-human perspectives to reflect on the positionality of intelligent agents and my own, and to materialize more-than-human alternatives [...] Instead of trying to speak on behalf, enacting other voices is a way for me to reflect on what might be otherwise hidden (possible assumptions embedded in a design and my own assumptions). Moreover, enacting things as agents, and not as products, allows us to imagine how

design can be otherwise, and to rehearse alternative relations, i.e., to materialize new possible relations (making posthuman theory very tangible).”

DOENJA: “I learned to see decentering in research through design as an active, ongoing thing, in which I shifted focus to events rather than outcomes such as finished samples or validated experiences. This shift also helped me in untangling deeply rooted design goals of efficiency, cause and effect, success or failure, and innovation – framings that don’t keep much space for the unintended, uncontrollable and ineffable. Yet, there is much more needed to untangle design further, to understand where our assumptions come from. I am therefore interested in further unlearning, and making room for unusual, non-western and non-progressional ways of designing. This might also mean letting go of the constitution of the designer as a singular unit with ownership over their projects. The works discussed in my reflections are all part of ongoing collaborations with humans and nonhumans alike, and I am aware of the power I have in presenting and reflecting on them as I have. For example, I chose to withhold imagery and further details of the design work with the indigenous weaver, as it is not fully mine to speak on behalf of – and I feel somewhat conflicted in including it at all. The next step in decentering myself may be to understand better what it means to write about, present, and think with these projects as an ongoing part of a constituency.”

HEIDI: “Overall, decentering to me is a way to phenomenologically peel back layers of norms and assumptions and ask if these norms and assumptions are desirable, for whom, and if we want to do otherwise.”

3.4. *Implications of decentering as an ongoing material practice*

Looking at decentering as an ongoing practice suggests that it should not be understood as an ultimate goal. As Livio and Devendorf (2022) proposed, decentering might be more productive when it is “a horizon to guide movement that is concurrently understood to remain continually beyond reach” (page 10). Instead of pursuing it as a goal, they suggest that critically considering how the relationships and power dynamics present in the simple aim of decentering is more important, as this can reveal other arrangements or subversions to choose from. Looking at decentering as a material practice, highlights that decentering can produce knowledge that is not bound to writing, nor to academic contexts. This sheds light on how different types of gatherings and alternative formats (e.g., events, workshops, and design activities) could be important modes of production and dissemination of posthuman knowledge; and can potentially help posthuman scholars to move beyond the textual realm, which is a human-centered form. This is illustrated in some of our reflections:

IOHANNA: “Beyond readings, some of the turning moments were developed in encounters, such as conversations and panel discussions, workshops, and design experiments [...] Decentering as a concept has also taken shape through teaching, summer classes, exhibitions, and podcasts.”

The differences in how designers approach and practice decentering might make it challenging to find a common ground, but it can also create opportunities to work out the nuances of theoretical differences through material encounters. Reflecting on our own practices and sharing our insights – but even more so our doubts and vulnerabilities – was especially generative for that aim. For example, through the

differences we recognized “chips” (as Heidi put it) in our cornerstones, which signaled the need to keep challenging ourselves and the motivation to create more open spaces to learn from each other.

HEIDI: “More recently, following critiques of the posthuman and ontological turn by African American Studies and Indigenous scholars. I see how some of my cornerstones have chips in them and are also not perfect or complete. Therefore, I have more recently sought case studies and subjects that will challenge posthumanism – for all its claims to be decolonial and interdisciplinary – to grapple and intersect with human/human problems. In recent work, I began to ask these questions using duoethnographic map making (see [Figure 10](#)) with my collaborators, Shaowen Bardzell, a feminist HCI scholar, and Shellye Suttles, and Agricultural Economist studying sustainable food systems. We mapped how historic redlining in Indianapolis, a historic data practice of assessing property that denied African American communities subsidized home loans, is related to present-day sustainability issues (Heidi et al., 2023). This type of decentering was about finding multiple entry points to the problems of sustainability and understanding how disciplines shape how we see sustainability. It was also about asking how human/nonhuman relations are entangled with human/human challenges like racialized historic data practices and exposure to environmental harms.”

4. Decentering through design

Beyond surfacing productive similarities and differences, the last section strongly positioned the notion of decentering within practices and characterized it as one that is ongoing and material . In this section,

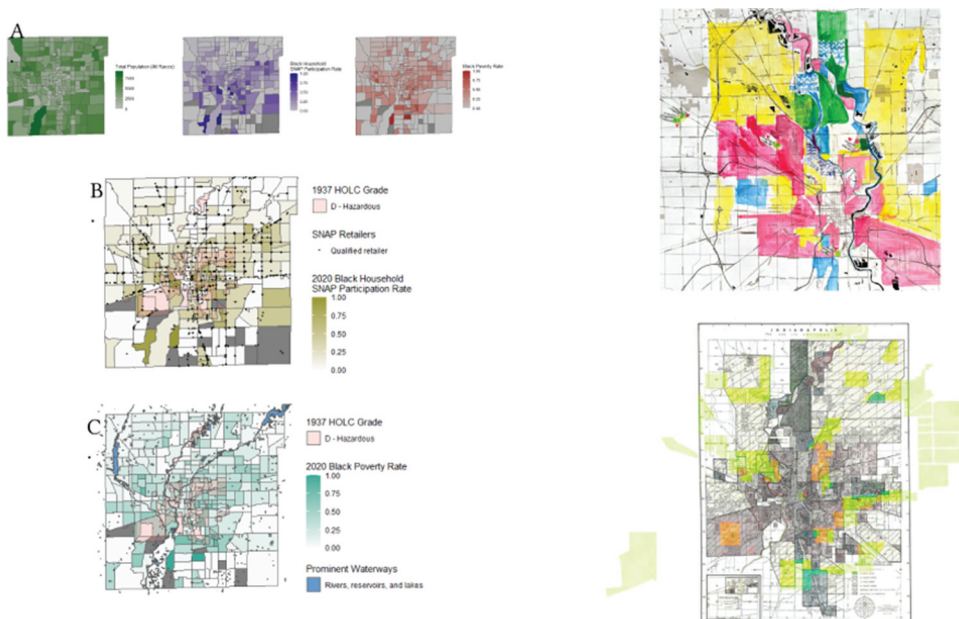


Figure 10. Heidi Biggs' more-than-human maps of Indianapolis and redlining (right) contrasted with their collaborator's maps (left). Maps were used as a tool to decenter each other's disciplinary orientations toward sustainability, as well as the multiple levels and scales of the impacts of historic redlining on sustainability and track how human/nonhuman intersections relate to human/nonhuman challenges (Heidi et al., 2023).

we take those insights to start articulating what a more-than-human practice of *decentering through design* might be like, focusing on the emerging themes of movement and materiality.

4.1. *Moving by staying still*

Movement appears to be an effective strategy for addressing the complexities associated with decentering, especially the inherent challenge of humans not being able to fully decenter themselves. Extending from decentering in HCI to the broader scope of the posthuman turn, Grusin's (2015) characterization of the nonhuman turn as a continuous "turning towards" emphasizes the importance of contingency and movement. Considering decentering as an ongoing practice prompts questions like: how can movement guide designers' actions? Throughout this article, we have shown examples of decentering trajectories as movements that are not teleological, but multiple and emergent. Our reflections showed that we constantly move to new spaces and learn new practices in order to decenter ourselves by staying uncomfortable. We have also shown that knowledge around decentering was developed in different formats and sites, many of them being events, workshops, and human or nonhuman encounters.

While our practices expanded decentering in relation to movement, they did not see movement as progress. Instead, our practices proposed to slow down, unmake, and problematize the established centers by exposing the ecologies, infrastructures, and limitations of our designs. That is in line with how Giaccardi (2020), describes decentering, as a move meant to configure the scope of design work and generate futures, as it concerns "fundamentally new alliances for making sense, framing and bringing into existence things that do not exist yet – which is at the essence of design work" (p. 124). A design practice that decenters the human by considering nonhuman perspectives, can even problematize the design space instead of reinforcing existing blind spots and dominant biases. It can "unsettle a designer's assumptions, demonstrate the problem to be more uncertain, more nuanced or more complex than originally assumed or regarded." (p. 126)

This last remark about decentering as reconfiguration, rises an important question: Can we find movement also in quiet circumstances? It is crucial to think about that given the environmental challenges and the need for designers to rethink the way they make things and subvert the models that maximize extraction and production. In "Doing and Undoing Post-Anthropocentric Design" Jönsson et al. (2022) write:

In face of increasingly uncertain and bleak futures dominated by probabilistic logics of prediction, extraction and human exceptionalism, it is crucial for design to develop undisciplined and pluriversal approaches [...] to critically rethink the modern, colonialist, and anthropocentric inheritance that resonates in and through design cultures. (p. 1)

Along those lines, an emergent perspective that can help imagine decentering through subtle movements is the work on un/making (Sabie et al., 2022). Considering this perspective, future work can more explicitly position decentering in relation to notions like slow technology (Odom et al., 2022), undoing (Jönsson et al., 2022), pause (Friedman & Yoo, 2017), refusal (Garcia et al., 2020), cracks (Howell et al., 2021), misunderstandings (Nicenboim et al., 2022), malfunction (Sturdee et al., 2020) and repair (Blanco-Wells, 2021).

Ultimately, this humbler approach to decentering brings more nuance to the question "how can designers know when they are decentered enough?" By focusing on decentering as a practice, and paying attention to the process, designers could reflect on subtle shifts rather than striving for significant strides. Going back to Grusin's (2015) remarks on the movement implied in turning, decentering can be simply "a shift of attention, interest, or concern." Although that seems simple, it is radical as it can allow us to account for more-than-human entanglements and ultimately to "move aside so that other nonhumans – animate and less animate can make their way, turn toward movement themselves" (p. 21).

4.2. *Materializing posthuman theory*

By conceptualizing decentering through design, it seems inevitable to attend to the material. Given the unique position we are in, as designers and HCI researchers, to work in the interplay between materials and matters of concern, we ask in which ways decentering through design can materialize the feminist, decolonial thinking that grounds posthuman theory. Then, we bring more nuances to that argument by contextualizing it more broadly within posthumanism, asking whether the examples shown in this paper could account for a designerly way of “making” posthuman theory through design.

As the literature we presented and the personal reflections have highlighted, while the notion of decentering is grounded in theoretical developments, designers have created concrete exemplars, methods, and tactics. The particular ways in which decentering is enacted through design can be understood as a way of “materializing” critical posthuman theory (Braidotti, 2019). That is interesting in relation to our personal reflections because it is precisely the materials we use that make our inquiries situated. Thinking about the situatedness of decentering responds to the call for posthuman practices that are “materialist and vitalist, embodied and embedded, firmly located somewhere” (Braidotti, 2013, p. 51). Drawing from the evidence provided in this paper, we argue that decentering in design cannot be solely understood through theoretical frameworks. It is intrinsically linked with the activities, tools, and challenges inherent in the design process. Moreover, it is connected to the responsibilities, capacities, and identities of both humans and nonhumans involved in these processes (Goodman, 2013).

Although the materials employed were instrumental in contextualizing our decentering practices, our reflections further indicate that materializing posthuman theory goes beyond merely using physical materials to implement posthuman concepts. Designers may be uniquely positioned to develop situated approaches for decentering. Some of the ways in which designers do that is by developing methods to notice and listen to more-than-human entanglements, by enacting different perspectives through material speculations, and by materializing alternative relations in the forms of everyday things that are based on alternative values such as care, kinship, and co-habitation.

In turn, we can ask: what could this focus in materiality add to the notion of decentering? Given that the materials used in design are evolving into complex assemblages of both humans and nonhumans – such as data and algorithms – it becomes essential to consider how practices of attunement might be extended to broader temporal and physical scales. Additionally, the increasing agency manifested in many automation technologies necessitates not only the recognition of the designer’s positionality but also the exposure of the positionality of the agents we design. Crucially, materials introduce new methodological challenges; tools reliant on data, including processes like labeling and filtering, often contain latent anthropocentric biases that must be acknowledged. Consequently, a comprehensive consideration of materiality not only extends practices of decentering to larger assemblages and scales but also prompts designers to critically evaluate the tools employed in their inquiries.

Lastly, by engaging in critical reflection on Braidotti’s invitation, we can gain insight into the gaps, or areas that still require attention. Looking at decentering as a process that happens not only in theory but in practice, makes us reflect on possible “practices of centering.” This can be what scholars in STS have called alterity (F. Lee, 2022) the process of making “otherness” by forgetting, omitting, and not making those “others” a matter of concern. This highlights that moving away from anthropocentrism should not only be studied in relation to large paradigm shifts but also encountered in more subtle and mundane design decisions and tools. Another aspect that is related to that claim is that issues of power and decoloniality might need to be better articulated in the post-humanist HCI discourse. While we formed one cluster around the notion of power, we believe that that aspect has not been fully explored in our current practices. This invites us to think that further collaborations are needed to bridge this gap. In relation to power, the notion of decentering, as a dualism of center/periphery could be critically reviewed to avoid falling back into binaries.

5. Making posthuman knowledge through design

By expanding our focus from merely theoretical and methodological aspects of decentering to the practical activities, tools, and challenges that designers face, this article firmly establishes decentering within design and HCI as an evolving material practice. This shift – from treating decentering as a final objective to seeing it as an ongoing process – brings into focus the roles, capabilities, and identities of both humans and nonhumans in specific design settings. This perspective aligns with Wakkary's description of nomadic practices (Wakkary, 2020), practices that generate situated, embodied, and partial forms of knowledge rather than adhering to an objectivist or universalist framework. It also resonates with Redström's assertion that design is a knowledge-creating discipline, not merely a domain for the application of existing theories (Redström, 2017). Consequently, our articulation of these practices serves dual purposes: it not only grounds the notion of decentering but also underscores the epistemic contributions that design can make to philosophical discussions.

Tracing decentering in the interplay between theory and practice enabled us to grapple with the complexities in both making theory and making design, particularly when dealing with decentering as a contingent and situated concept. The article did not offer a singular definition of decentering but rather presented a range of interpretations as they are understood in HCI and design. These definitions were not prescriptive but expansive, allowing for emergence (Gaver et al., 2022) and drifting (Krogh & Koskinen, 2020). Additionally, because these definitions were grounded in specific design projects, they extended beyond the purely textual, thereby challenging human-centered paradigms of knowledge production in favor of more situated and embodied approaches.

Anchoring decentering within practices, and aligning it with posthuman epistemological commitments to knowledge production, brings forth both opportunities and limitations, as well as avenues for future work. One opportunity is the shift in research focus from simply applying concepts and methods to practices, to establishing generative intersections between posthuman theory and more-than-human practices. Here, decentering can be both grounded in conceptual advancements in the field and also be situated, multiple, and generative. However, to achieve that, it is important to consider some of the limitations of this article and suggest possible ways to address them. One limitation is that our review covers either published work, or our own practices. Since decentering is practiced in many ways beyond academic contexts, a broader overview of decentering within design practices is essential to provide a more comprehensive understanding of it. But since any review runs the risk of centering certain perspectives at the expense of others, future studies should aim for plurality, encompassing diverse geographical locations, cosmologies, and methodologies. A second limitation of this article is that, given the urgency of the societal and environmental challenges we are facing, it seems important to articulate more concretely what more-than-human practices un/make. In other words, while positioning decentering strongly within practices has helped us to move closer to articulating what new angles, footholds, and dispositions decentering offers for designers, it is still necessary to illustrate how decentering can be productive in opening for more livable entangled futures.

We hope that the contributions of this article can provide a lexicon for more-than-human designers, enabling them to more clearly contextualize their decentering practices in relation to posthuman theory, while simultaneously allowing for emergent practices – with open-ended exploration, novel methodologies, and diverse viewpoints. We intend for this work to offer posthuman designers and researchers a stable foundation from which various theoretical turns and practical movements can be enacted. Ultimately, we hope that the article contributes to understanding how conceptual shifts in the posthuman turn get materialized and made through design.

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Notes on contributors

Iohanna Nicenboim is a speculative designer and researcher, currently a PhD candidate at Delft University of Technology. Funded by a Microsoft Research Scholarship, the PhD investigates AI through more-than-human design. In the last years, she has been developing more-than-human design methods and using them to design provocations that combine posthuman feminist theory with critical design to imagine more situated and response-able interactions with conversational agents. Iohanna has led a workshop at DIS2020 on More-than-human design and co-organized a panel on that topic at CHI2021.

Doenja Oogjes is a design researcher interested in indirect, accidental, surprising, and overlooked ways designed things mediate the everyday. She investigates more-than-human thinking in design, currently focusing on digital craftsmanship. Doenja uses research-through-design, speculative design and first-person design. She is an assistant professor at the department of Industrial Design, TU/e, and completed her PhD research at Simon Fraser University in Vancouver, Canada. Her work is published in conferences such as ACM CHI, DIS and TEI, where it has received several best paper and honorable mention awards.

Heidi Biggs (they/she) has an interdisciplinary background, holding a B.A. in English and a Master of Design degree from the University of Washington and PhD in Informatics from Penn State University. Their work asks how technology and data build relations between bodies and land. Guided by ecological posthuman theory which grapples with climate change and the Anthropocene they seek to illustrate, make tangible, trouble, and ground these relations through making, interdisciplinary dialogues, and first-person accounts. They generate critical readings and reimaginings of environmental data and expanded definitions of sustainability in computing research.

Seowoo Nam is a design researcher who explores emergent, entangled, situated, and relational aspects of interactions with data and algorithms. In particular, she is interested in how data is collected, generated, interpreted, and operated in smart environments, from smart forests to smart oceans and smart agriculture. At the intersection of design, computer science, and urban studies, her current research takes a more-than-human design approach to digital twin simulations of the urban forest. By critically examining how digital technologies shape our notions of and relationships with the environment, she seeks alternative modes of becoming and knowing. She completed her MSc in Industrial Design Engineering at Delft University of Technology.

ORCID

Iohanna Nicenboim  <http://orcid.org/0000-0002-8363-8282>

References

- Akmal, H., & Coulton, P. 2020. "The divination of things by things." In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–12. CHI EA '20. New York, NY, USA: Association for Computing Machinery.
- Barad, K. (2007). *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Duke University Press.
- Behzad, A., Wakkary, R., Oogjes, D., Zhong, C., & Lin, H. 2022. "Iterating through feeling-with nonhuman things: Exploring repertoires for design iteration in more-than-human design." In *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–6. CHI EA '22 278. New York, NY, USA: Association for Computing Machinery.
- Biggs, H., Suttles, S., & Bardzell, S. 2023. Redlining maps and terrains of sustainability: Interdisciplinary mapping of racialized redlining to present-day sustainability agendas in HCI." In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems (CHI '23)*. Association for Computing Machinery, New York, NY, USA, Article 141, 1–18. <https://doi.org/10.1145/3544548.3581491>

- Biggs, H. R., Bardzell, J., & Bardzell, S. 2021. "Watching myself watching birds: Abjection, ecological thinking, and posthuman design." In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–16. 619. New York, NY, USA: Association for Computing Machinery.
- Biggs Heidi, R., & Desjardins, A. 2020. High water pants: Designing embodied environmental speculation. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–13. <https://doi.org/10.1145/3313831.3376429>
- Blanco-Wells, G. (2021). Ecologies of repair: A post-human approach to other-than-human natures. *Frontiers in Psychology*, 12(April), 633737. <https://doi.org/10.3389/fpsyg.2021.633737>
- Bødker, S. (2015). Third-wave HCI, 10 Years Later—participation and sharing. *Interactions*, 22(5), 24–31. <https://doi.org/10.1145/2804405>
- Braidotti, R. (2013). *The posthuman* (1st ed.). Polity.
- Braidotti, R. (2019). *Posthuman knowledge* (1st ed.). Polity.
- Cooper, G., & Bowers, J. (1995). Representing the user: Notes on the disciplinary rhetoric of human-Computer Interaction. P. J. Thomas (Ed.), In *The social and interactional dimensions of human-computer interfaces* (pp. 48–66). Cambridge University Press.
- Coskun, A., Cila, N., Nicenboim, I., Frauenberger, C., Wakkary, R., Hassenzahl, M., Mancini, C., Giaccardi, E., & Forlano, L. 2022. "More-than-human concepts, methodologies, and practices in HCI." In *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–5. CHI EA '22 150. New York, NY, USA: Association for Computing Machinery.
- Coulton, P., & Lindley, J. (2019). More-than human centred design: Considering other things. *Design Journal*, 22(4), 463–481. <https://doi.org/10.1080/14606925.2019.1614320>
- Deleuze, G., & Parnet, C. (2007). *Dialogues II*. Columbia University Press.
- Devendorf, L., De Kosnik, A., Mattingly, K., & Ryokai, K. 2016. "Probing the potential of post-anthropocentric 3D printing." In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems*, 170–81. DIS '16. New York, NY, USA: Association for Computing Machinery.
- Devendorf, L., & Ryokai, K. 2015. "Being the machine: Reconfiguring agency and control in hybrid fabrication." In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, 2477–86. CHI r'15. New York, NY, USA: Association for Computing Machinery.
- Di Salvo, C., & Lukens, J. (2012). Nonanthropocentrism and the nonhuman in design: Possibilities for Designing New forms of engagement with and through Technology. In M. Foth, Forlano, L., Satchell, C., Gibbs, M. (Ed.), *From social butterfly to engaged citizen: urban informatics, social Media, ubiquitous computing, and mobile technology to support citizen engagement* (pp.421-435). Cambridge: MIT Press .
- Dörrenbächer, J., Löffler, D., & Hassenzahl, M. 2020. "Becoming a robot - overcoming anthropomorphism with Techno-Mimesis." In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–12. CHI '20. New York, NY, USA: Association for Computing Machinery.
- Ferrando, F. (2019). *Philosophical Posthumanism*. Theory in the New Humanities. Bloomsbury Publishing.
- Forlano, L. (2016). Decentering the human in the design of collaborative cities. *Design Issues*, 32(3), 42–54. https://doi.org/10.1162/DESI_a_00398
- Forlano, L. (2017). Posthumanism and Design. *The Journal of Design Economics and Innovation*, 3(1), 16–29. <https://doi.org/10.1016/j.sheji.2017.08.001>
- Forlano, L. (2023). Living intimately with machines: Can AI be disabled? *Interactions*, 30(1), 24–29. <https://doi.org/10.1145/3572808>
- Frauenberger, C. (2019). Entanglement HCI the next wave? *ACM Transactions on Computer-Human Interaction*, 27(1), 1–27. <https://doi.org/10.1145/3364998>
- French, F., Mancini, C., & Sharp, H. 2020. "More than human aesthetics: Interactive enrichment for elephants." In *Proceedings of the 2020 ACM Designing Interactive Systems Conference*, 1661–1672. DIS '20. New York, NY, USA: Association for Computing Machinery.
- Friedman, B., & Yoo, D. 2017. "Pause: A Multi-Lifespan Design Mechanism." In *CHI 2017. Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (pp. 460–464). New York, NY, USA: Association for Computing Machinery.
- Garcia, P., Sutherland, T., Cifor, M., Say Chan, A., Klein, L., D'Ignazio, C., & Salehi, N. 2020. "No: Critical refusal as feminist data practice." In *Conference Companion Publication of the 2020 on Computer Supported Cooperative Work and Social Computing*, 199–202. CSCW '20 Companion. New York, NY, USA: Association for Computing Machinery.
- Gaver, W., Gall Krogh, P., Boucher, A., & Chatting, D. 2022. "Emergence as a feature of practice-based design research." In *Designing Interactive Systems Conference*, 517–526. DIS '22. New York, NY, USA: Association for Computing Machinery.
- Giaccardi, E. (2018). Things making things: Designing the internet of reinvented things. *IEEE Pervasive Computing*, 17(3), 70–72. (8490177). <https://doi.org/10.1109/MPRV.2018.03367737>
- Giaccardi, E. (2020). Casting things as partners in design: Towards a more-than-human design practice. In H. Wiltse (Ed.), *Relating to things: Design, technology and the artificial*, (pp. 99–132). London: Bloomsbury Academic.

- Giaccardi, E., Cila, N., Speed, C., & Caldwell, M. 2016. "Thing ethnography: Doing design research with non-humans." In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems*, 377–387. ACM.
- Giaccardi, E., & Redström, J. (2020). Technology and more-than-human design. *Design Issues*, 36(4), 33–44. https://doi.org/10.1162/desi_a_00612
- Goodman, E. S. (2013). *Delivering design: Performance and materiality in professional Interaction design*. University of California. <https://www.proquest.com/openview/97cce0e98eda0162e2f95c5bedeeb80b/1?pq-origsite=gscholar&cbl=18750>
- Grusin, R. (Ed.). (2015). *The nonhuman turn (21st Century studies)* (1st ed.). Univ Of Minnesota Press.
- Guattari, F., & Deleuze, G. (1987). *Thousand Plateaus: Capitalism and Schizophrenia*. University of Minnesota Press.
- Haraway, D. J. (2016). *Staying with the trouble: Making kin in the chthulucene*. Duke University Press.
- Harrington, C., Erete, S., & Marie Piper, A. (2019). Deconstructing community-based collaborative design: Towards more equitable participatory design engagements. *Proceedings of the ACM on Human-Computer Interaction* 216, 3 (CSCW), 1–25. <https://doi.org/10.1145/3359318>
- Helms, K., Louise Juul Søndergaard, M., & Campo Woytuk, N. 2021. "Scaling bodily fluids for utopian fabulations." In *Nordic Design Research Conference*. <http://kth.diva-portal.org/smash/record.jsf?pid=divDoe/ja/3IOHANNA573882&dsid=-1557>.
- Homewood, S., Hedemyr, M., Fagerberg Ranten, M., & Kozel, S. 2021. "Tracing conceptions of the body in HCI: From user to more-than-human." In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–12. CHI '21 258. New York, NY, USA: Association for Computing Machinery.
- Howell, N., Desjardins, A., & Fox, S. (2021). Cracks in the success narrative: Rethinking failure in design research through a retrospective trioethnography. *ACM Transactions on Computer-Human Interaction*, 28(6), 1–31. <https://doi.org/10.1145/3462447>
- Ingold, T. (2017). On human correspondence. *The Journal of the Royal Anthropological Institute*, 23(1), 9–27. <https://doi.org/10.1111/1467-9655.12541>
- Jönsson, L., Tironi, M., Hermansen, P., & Wilkie, A. 2022. "Doing and undoing post-anthropocentric design." In *DRS Biennial Conference Series*. <https://doi.org/10.21606/drs.2022.1068>.
- Key, C., Gatehouse, C., & Taylor, N. 2022. "Feminist care in the Anthropocene: Packing and unpacking tensions in posthumanist HCI." In *Designing Interactive Systems Conference*, 677–692. DIS '22. New York, NY, USA: Association for Computing Machinery.
- Klumbyte, G., & Claude, D. (2022). Prospects for a New materialist informatics: Introduction to a special issue. *Matter: Journal of New Materialist Research*, 3(1). <https://doi.org/10.1344/jnmr.v3i1.38955>
- Krogh, P. G., & Koskinen, I. (2020). *Drifting by intention* (2020). Springer International Publishing.
- Kuijter, L., & Giaccardi, E. 2018. Co-performance: Conceptualizing the role of artificial agency in the design of everyday life. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. Association for Computing Machinery, New York, NY, USA, Paper 125, 1–13. <https://doi.org/10.1145/3173574.3173699>
- Lee, F. 2022. Ontological overflows and the politics of absence: Zika, disease surveillance, and mosquitos at the ECDC. SocArXiv. <https://doi.org/10.31235/osf.io/e5ju9>
- Liu, S.-Y., Bardzell, J., & Bardzell, S. 2019. "Decomposition as design: Co-creating (with) natureculture." In *Proceedings of the Thirteenth International Conference on Tangible, Embedded, and Embodied Interaction*, 605–614. TEI '19. New York, NY, USA: Association for Computing Machinery.
- Liu, J., Byrne, D., & Devendorf, L. 2018. "Design for collaborative survival: An inquiry into human-fungi relationships." In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, 1–13. CHI '18. New York, NY, USA: Association for Computing Machinery.
- Liu, S.-Y., Liu, J., Dew, K., Zdziarska, P., Livio, M., & Bardzell, S. 2019. "Exploring noticing as method in design research." In *Companion Publication of the 2019 on Designing Interactive Systems Conference 2019 Companion*, 377–380. DIS '19 Companion. New York, NY, USA: Association for Computing Machinery.
- Livio, M., & Devendorf, L. 2022. "The eco-technical interface: Attuning to the instrumental." In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–12. CHI '22 101. New York, NY, USA: Association for Computing Machinery.
- Morton, T. 2013. "Hyperobjects: Philosophy and Ecology After the End of the World." *University of Minnesota Press*. <http://www.jstor.org/stable/10.5749/j.ctt4cggm7>.
- Murray-Rust, D., Gorkovenko, K., Burnett, D., & Richards, D. 2019. "Entangled ethnography: Towards a collective future understanding." In *Proceedings of the Halfway to the Future Symposium 2019*, :21:1–:21:10. HTTF 2019. New York, NY, USA: ACM.
- Nicenboim, I., Giaccardi, E., & Redström, J. 2022. "From explanations to shared understandings of AI." In *DRS Biennial Conference Series*. <https://doi.org/10.21606/drs.2022.773>.
- Nicenboim, I., Giaccardi, E. & Redström, J.(2023). Designing more-than-human AI: Experiments on situated conversations and silences. *Did — Disegno Industriale Industrial Design*, 80, 12. <https://doi.org/10.30682/diid8023c>.
- Nicenboim, I., Giaccardi, E., & Schouwenaar, M. 2018. "Everyday entanglements of the connected home." In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems (CHI EA '18)*. Association for Computing Machinery, New York, NY, USA, Paper VS04, 1. <https://doi.org/10.1145/3170427.3186596>

- Nicenboim, I., Venkat, S., Linn Rustad, N., Vardanyan, D., Giaccardi, E., & Redström, J. 2023. "Conversation Starters: How Can We Misunderstand AI Better?" In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems (CHI EA '23)*. Association for Computing Machinery, New York, NY, USA, Article 431, 1–4. <https://doi.org/10.1145/3544549.3583914>
- Nordmoen, C. 2020. "Decentering the human in digital making - towards embodied mattering." In *Companion Publication of the 2020 ACM Designing Interactive Systems Conference*, 543–547. DIS' 20 Companion. New York, NY, USA: Association for Computing Machinery.
- Odom, W., Stolterman, E., & Yo Sue Chen, A. (2022). Extending a theory of slow Technology for design through artifact analysis. *Human–Computer Interaction*, 37(2), 150–179. <https://doi.org/10.1080/07370024.2021.1913416>
- Oogjes, D., & Wakkary, R. 2022. "Weaving Stories: Toward Repertoires for Designing Things." In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–21. CHI '22 98. New York, NY, USA: Association for Computing Machinery.
- Oogjes, D., Wakkary, R., Lin, H., & Alemi, O. 2020. "Fragile! handle with care: The morse things." In *Proceedings of the 2020 ACM Designing Interactive Systems Conference* Eindhoven Netherlands, 2149–2162.
- Plummer-Fernandez, M. 2019. The art of bots: A practice-based study of the multiplicity, entanglements and figuration of sociocomputational assemblages. Goldsmiths, University of London.
- Reddy, A., Baki Kocaballi, A., Nicenboim, I., Louise Juul Søndergaard, M., Luce Lupetti, M., Key, C., Speed, C., Lockton, D., Giaccardi, E., Grommé, F., Robbins, H., Primlani, N., Yurman, P., Sumartojo, S., Phan, T., Bedö, V., Strengers, Y. 2021. "Making everyday things talk: Speculative conversations into the future of voice Interfaces at home." In *Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–16. CHI EA '21 23. Yokohama Japan: New York, NY, USA: Association for Computing Machinery.
- Redström, J. (2017). *Making design theory*. The MIT Press.
- Redström, J., & Wiltse, H. (2018). *Changing things: The future of objects in a digital world*. Bloomsbury Visual Arts.
- Sabie, S., Song, K. W., Parikh, T., Jackson, S., Paulos, E., Lindstrom, K., Ståhl, Å., Sabie, D., Andersen, K., & Wakkary, R. 2022. "Unmaking@chi: Concretizing the material and epistemological practices of unmaking in HCI." In *Extended Abstracts of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–6. CHI EA '22 105. New York, NY, USA: Association for Computing Machinery.
- Smith, N. E. (2019). *Decentering design: Bees, biomimicry, and the sixth mass extinction*. Indiana University. <https://www.proquest.com/openview/752b8498bf06b8bc8ab5d65a5499af28/1?pq-origsite=gscholar&cbl=18750&diss=y>
- Smith, N., Bardzell, S., & Bardzell, J. 2017. "Designing for cohabitation: Naturecultures, hybrids, and decentering the human in design." In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, 1714–1725. CHI '17. New York, NY, USA: Association for Computing Machinery.
- Stricklin, C., & Nitsche, M. 2020. "Primal Clay: Worldbuilding with the New materialism." In *Proceedings of the 15th International Conference on the Foundations of Digital Games*, 1–4. FDG '20 43. New York, NY, USA: Association for Computing Machinery.
- Sturdee, M., Lindley, J., Harrison, R., & Kluth, T. 2020. "The seven year glitch: Unpacking beauty and despair in malfunction." In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–11. CHI EA '20. New York, NY, USA: Association for Computing Machinery.
- Tironi, M., Chilet, M., Marín, C. U., & Hermansen, P. (Eds.). (2023). *Design for more-than-human futures: Towards Post-Anthropocentric Worlding* (1st ed.). Routledge. <https://doi.org/10.4324/9781003319689>
- Tomico, O., Wakkary, R., & Andersen, K. (2023). Living-with and Designing-with plants. *Interactions*, 30(1), 30–34. (January - February 2023) <https://doi.org/10.1145/3571589>
- Tran O'Leary, J., Zewde, S., Mankoff, J., & Rosner, D. K. 2019. "Who gets to future? Race, representation, and design methods in africatown." In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–13. CHI '19. New York, NY, USA: Association for Computing Machinery.
- Tsing, A. L. (2015). *On the possibility of life in capitalist ruins*. Princeton University Press.
- Wakkary, R. (2020). Nomadic practices: A posthuman theory for knowing design. *International Journal of Design*, 14 (3), 117–128.
- Wakkary, R. (2021). *Things we could design: For more than human-centered worlds (design thinking, design theory)*. The MIT Press.
- Wakkary, R., Oogjes, D., Hauser, S., Lin, H., Cao, C., Leo, M., & Duel, T. 2017. "Morse Things: A design inquiry into the gap between things and us." In *Proceedings of the 2017 Conference on Designing Interactive Systems*, 503–14. DIS '17. New York, NY, USA: Association for Computing Machinery.
- Yoo, D., Bekker, T., Dalsgaard, P., Eriksson, E., Skov Fougat, S., Frauenberger, C., Friedman, B., Giaccardi, E., Hansen, A.M., Light, A., Nilsson, E., Wakkary, R., Wilberg, M. 2023. "More-than-human perspectives and values in human-Computer Interaction." In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems (CHI EA '23)*, 5. ACM, New York, NY, USA.