



# Nomadic Practices: A Posthuman Theory for Knowing Design

**Ron Wakkary**

*School of Interactive Arts and Technology, Simon Fraser University, Surrey, Canada  
Industrial Design, Eindhoven University of Technology, Eindhoven, the Netherlands*

This article develops the theory of nomadic practices as an alternative to seeing design as a humanist discipline. Nomadic practices is an epistemological theory guided by posthumanist commitments of phenomenological intentionality, situated knowledges, and nomadism. In contrast to humanist understandings of design that rely on objectivist viewpoints and universalizing foundations, nomadic practices see knowledge production in design as situated, embodied, and partial. The aim of the theory of nomadic practices is to remove the epistemological hurdles of a disciplinary structure such that design practices can be more expansive and plural. The article builds on prior epistemological theories including Kuhn's (1962) *paradigms*, Redström's (2017) *programs*, and Agre's (1997) *generative metaphor* as seen through past changes and upheavals in what is considered design, such as Bødker's (2006) *third wave HCI* (human-computer interaction) or Harrison et al.'s (2007) *paradigms of HCI*. It then turns to key posthumanist concepts to articulate structural features of nomadic practices, namely 1) multiplicity of intentionalities; 2) situated knowing; and 3) nomadism. The contribution of this article is to offer a theory for thinking about design that embraces multiplicity and diversity rather than universalizing and singular ways of knowing design.

**Keywords** – Posthumanism, Discipline, Posthumanist Design, Intentionality, Nomadism, Epistemology

**Relevance to Design Practice** – This article offers a theory for knowing design that sees design practices as unique in terms of knowledge, methods, and intentionalities with respect to other design practices. It shows how design is pluralistic and independent of universalized principles and theoretical foundations of design characterized as a singular discipline.

**Citation:** Wakkary, R. (2020). Nomadic practices: A posthuman theory for knowing design. *International Journal of Design*, 14(3), 117-128.

## Introduction

In this article I propose the idea of nomadic practices as an alternative to conceiving of design as a humanist discipline. Nomadic practices is a theory for how we know and structure what we know about design that is guided by posthumanist concepts of intentionality (Verbeek, 2008), situated knowledges (Haraway, 1988), and nomadism (DeLanda, 2016; Deleuze & Guattari, 1987). The original aim of the theory was to create openings to investigate posthumanist design within an epistemological structure that avoids humanist ideals and assumptions, which is part of a forthcoming publication (Wakkary, 2021)<sup>1</sup>. Further, in removing these hurdles, design can be seen as more expansive and open to all kinds of different and concurrent explorations that go beyond posthumanist design. The contribution of this article is to offer a theoretical alternative to disciplines, as a way to liberate thinking about design to embrace multiplicity and diversity rather than universalizing and singular ways of knowing design.

Nomadic practices can be described as an epistemological theory. Epistemology concerns itself with how knowledge occurs and what form it takes. To date, conceptions of design draw on humanist understandings of a discipline as an autonomous body of knowledge that has clear boundaries with other disciplines. A characteristic of humanist disciplines is its reliance on objectivist viewpoints that are neutral and encompassing, and that the

knowledge produced aspires to be unified in its concepts to be seen as foundational or universal. By contrast, nomadic practices draw on posthumanist epistemologies in which knowledge production is situated, embodied, and partial—that is, knowledge is structured without foundations or universality but rather is nomadic in that it is constantly shifting and it is pluralistic.

By way of a brief introductory summary, nomadic practices view design as a multiplicity. This means that at any moment, a plurality of nomadic practices can call themselves design, or more accurately, a plurality of gatherings assembles around unique notions of design. These multiple gatherings do not compete over a single claim of the meaning of design. Rather, each is on its own path, pursuing a particular *something* of design, though open to intersections, divergences, contestations, or alliances. I describe this characteristic as a *multiplicity of intentionalities*. Additionally, nomadic practices are not structured on a universal or foundational knowledge like a discipline or subdiscipline.

**Received** July 21, 2020; **Accepted** Dec. 11, 2020; **Published** Dec. 31, 2020.

**Copyright:** © 2020 Wakkary. Copyright for this article is retained by the author, with first publication rights granted to the *International Journal of Design*. All journal content is open-accessed and allowed to be shared and adapted in accordance with the *Creative Commons Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) License*.

**\*Corresponding Author:** rwakkary@sfu.ca

Knowledge of a particular nomadic practice is situated within that nomadic practice. This means that there is no independent knowledge of design outside of any given nomadic practice, although each practice can overlap with others and collectively share what is known or has been accrued historically. I describe this characteristic as *situated knowing*. Lastly, nomadic practices are *nomadic*, as the name implies. This means that they are not about claiming domains or setting boundaries. Nomadic practices follow the somethings they design wherever they lead and, in this way, they traverse in parallel, almost always on the move. What makes a nomadic practice accountable is the quantity and quality of the gatherings around a particular something to design, or the ability to attract and create a shared intentionality. It is also accountable by who makes the claim that a particular nomadic practice is some kind of design, and not so much by the credentials of who makes the claim but that someone stands up to account for making the claim. Lastly, a nomadic practice is accountable for how it traverses the landscape and what it leaves behind.

For example, policy design as a nomadic practice is distinct from designing interactive products in that it does not hold the same concern for user experiences and related methods in any central way. It may traverse diverse territories of policy making from social justice issues to public health, crossing over into practices of epidemiology or economics in ways that could split into even more distinct though related nomadic practices. A nomadic practice of designing policy would attract different and diverse designers from those of interactive products. Its accountability would also be measured in vastly different ways. To rein policy design into a larger discipline of design or social science for that matter, such that it would need to conform to universalizing characteristics of either discipline, would be constraining and create unnecessary boundaries to available knowledge and past practices.

I start this article with a background discussion of related concepts and research. Then, I begin to develop the idea of nomadic practices by drawing on past attempts to reconsider disciplines that have been applied to design (Bødker, 2006; Harrison, Tatar, and Sengers, 2007; Redström, 2017), including *paradigms* (Kuhn, 1962), *programs* (Redström, 2017), and *generative metaphors* (Agre, 1997). I then turn to reshaping key elements toward a *posthumanist* framing by drawing on philosophical ideas of intentionality (Verbeek, 2008), situated knowledge (Haraway, 1988), and nomadism (Deleuze & Guattari, 1987). Lastly, I detail the structural features of a nomadic practice that I outlined above. I conclude with some of the possibilities that nomadic practices offer those who gather around their notion of design.

**Ron Wakkary** is a professor in the School of Interactive Arts and Technology, Simon Fraser University, where he is the founder of the Everyday Design Studio (eds.siat.sfu.ca). In addition, he is a professor in Industrial Design, Eindhoven University of Technology in the Netherlands. Wakkary's research investigates the changing nature of design and human-computer interaction in response to new understandings of human-technology relations and posthumanism. He aims to reflectively create new design exemplars, concepts, and emergent practices of design that help to shape both design and its relations to technologies. Wakkary is the author of the book *Things We Could Design: For More Than Human-Centered Worlds* (MIT Press, 2021).

## Background

Before engaging the theory of nomadic practices, I will briefly explain what I mean by humanism and posthumanism in relation to design, as these are framing concepts for the motivation and idea of nomadic practices. Given the space, this will be a simplified explanation and so I encourage readers to look elsewhere for a fuller discussion of the relations between humanism and posthumanism (e.g., see Braidotti, 2013; Verbeek, 2011). I also will briefly discuss related efforts to rethink design epistemologically to put this effort in context alongside approaches of other design researchers and theorists.

Humanism is a longstanding project dating back to the eighteenth and nineteenth century Europe in which scholars reinterpreted the ideals of classical Antiquity and the Italian Renaissance. The project is the enlightenment of what it is to be human and the privileging of human reason and ideals by placing these at the center of knowing and shaping of the world. This has led to a pervasiveness of humanist thought that continues throughout the modernist era to infuse itself in ways I think and act, as it likely is for how you think and act. The posthumanist thinker Braidotti describes humanism as the dominant model for human civilization. It is a structuring force for cultural practices that makes it pervasive in almost all matters of human life, from political ideals to legal principles to educational practices (Braidotti, 2013). Formulating design as a body of knowledge is as much an outcome of humanism as any other discipline. Epistemologically, humanist assumptions determine both how we gain knowledge about design and how that knowledge is structured. Ontologically, humanist assumptions view design as exclusively a human matter and, in doing so, privilege human values and perceptions.

Posthumanism informed by feminist and post-structuralist thinking grew out of the non-humanist to anti-humanist perspectives of the student rebellions of the 1960s (Braidotti, 2013). This philosophical or critical posthumanism draws on Haraway's (1988) principle of relationality or the necessity to *think-with*. In contrast to privileging of humans, the commitment is to always think-with other humans and nonhumans. To conceive of humans independently and distinctly is simply not possible nor desirable. This relational thinking decenters humans as the privileged and exclusive point of reference for thought and action. At its simplest, posthumanism is humans sharing center stage with nonhumans. This view of posthumanism is vastly different from what is often referred to as transhumanism or techno-humanism. These views envision a technological becoming of humans in which new technologies create a greater perfection of what it is to be human (see Bostrom, 2005; Hayles, 1999; Kurzweil, 2000; Moravec, 1999; Pilsch, 2017). Transhumanism, as such, is an intensifying of humanism and so the opposite of posthumanism as I consider it.

Unsurprisingly, in my explorations of a posthumanist understanding of design (Wakkary, 2021), it is clear that the humanist assumptions of design leave little room for nonhuman views. The current paradigm of human-centered design is not the only reason for this. The normative function of a discipline is to

establish foundational concepts and disciplinary boundaries. By virtue of defining what is a discipline it unavoidably excludes what it is not. But it is the aspiration of a discipline to be defined in universal terms that makes it truly exclusionary. Posthumanism, by contrast, puts little stake in foundational knowledge and even less so in universality. To know in posthumanism is a matter of relations that by virtue of making connections, seeking plurality, makes knowing expansive (or inclusionary) rather than exclusionary.

In addition to the ideal of universality, humanist disciplines rely on objectivist viewpoints to produce knowledge. What I mean by this is that it is assumed or implied that a neutral or unbiased position is possible and furthermore, available to any trained humanist, i.e., to not assume this position is to be biased or subjective. This objective view extends to a further aspiration of being all-encompassing or all-seeing from a particular perch on reality that in many respects is above-it-all or not of this world. By contrast, a posthumanist seeks active and ongoing positions of knowing within the limits of human subjectivity. In this sense, there is no neutral position available. Rather, a posthumanist is uniquely entangled with the world and in constant formation or becoming human as a way to know (Braidotti, 2013). Further, posthumanism is grounded in a materialist understanding, an acknowledgment of our deep entanglements with the world. As such, it assumes an embodied position that has no ability to rise above this world for an all-encompassing view.

The humanist position that I have simply sketched out here is not to be confused with the various approaches of the humanities from which much of the non-humanist to anti-humanist perspectives emerged. For example, such scholarship implicitly rejects disciplinary thinking, as many of its adherents embrace minoritarian positions of belonging to minor sciences or *studies* over disciplines (Braidotti, 2012; DeLanda, 2016; Deleuze & Guattari, 1987), whether science studies, feminist studies, technology studies, or animal studies. The positions of these thinkers avoid labels of subdisciplinary, multidisciplinary, interdisciplinary, or even transdisciplinary in a further disavowal of humanist precepts and ideals of knowing, a lesson that can be learned by designers and equally applied to the diversity of design practices.

Of course, design as a discipline is not monolithic nor undisputed. If anything, the discipline has been subject to ongoing critique, constant critical reflections, and a never-ending series of radical rebuilding. It is a short history full of upheavals and disruptions. I will describe some of these upheavals in detail in the next section as they played out in human-computer interaction (HCI) as paradigmatic change of the second to third wave HCI or generative metaphors of embodiment over mental cognition. I could have easily chosen one of the many such changes that have occurred over and over, such as the shift to reflective practice from technical rationality (Schon, 1984), or the move to a design cognition of designerly ways of knowing from design as a science (Cross, 2006), or the semantic turn toward human-centered design from technology-centered design (Krippendorff, 2006). More recently, adherents have argued for an ontological design (Escobar, 2018; Fry, 1999) or feminist correctives of the ongoing reformulations of the foundation of design (Rosner, 2018).

Lastly, posthumanism, non-humanism, and related philosophies of technology that I draw on here are not new discussions within design. For example, there is a vibrant and wide ranging discussion that includes agential realism (Frauenberger, 2019), Anthropocene (Light et al., 2017), human-machine configurations (Andersen et al., 2019; Devendorf & Ryokai, 2015; Leahu, 2016), material aesthetics (Van Dongen, 2019), natureculture (Liu et al., 2018; Smith et al., 2017), object ontologies (Encinas et al., 2020; Lindley et al., 2017), postanthropocentricism (Devendorf et al., 2016; DiSalvo & Lukens, 2011), technological mediation (Hauser, 2018; Hauser et al., 2018; Pierce & Paulos, 2013; Wakkary et al., 2018; Wiltse & Stolterman, 2010), and thing-centeredness (Giaccardi et al., 2016; Oogjes & Wakkary, 2017; Wakkary et al., 2017).

This article is a contribution to the ongoing discussion of humanist thinking in design and its alternatives. It builds on this work but, moreover, aims to address the challenge of implicitly or explicitly universalizing a given position. More to the point, the theory of nomadic practices is an attempt to formulate an expansive and pluralistic conception of design practices.

## Paradigms, Programs, and Generative Metaphors

The development of nomadic practices begins with drawing on prior ways of reconceptualizing science, technical practices, and design. These include paradigms (Kuhn, 1962), programs (Redström, 2017), and generative metaphors (Agre, 1997). There are many characteristics and elements to be taken from these approaches that I will expand on and some shortcomings that, for my aims, I will address.

### Paradigms

Paradigms or paradigm shifts argued by Kuhn (1962) are a radical rethinking of science and progress. It recasts the development of science from being a progressive trajectory of increasing approximations of scientific truths to a series of disruptive breaks between different scientific paradigms. A paradigm, according to Kuhn, is an exemplar in science, such as Ptolemy's calculations of planetary movements, Newton's laws of motion and gravity, or Maxwell's theory of the electromagnetic field. These paradigms, in a given period, provide the theoretical beliefs, values, instruments and techniques to solve scientific problems. The capacity for a paradigm to contribute to scientific problem-solving is what Kuhn refers to as a period of *normal* science. Here, for a given time, the goals, theories, and experimental approaches to science adhere to the paradigmatic theory in a cumulative and productive fashion that we tend to think of as scientific progress.

Kuhn's radical departure is to make the case that stable periods of *normal* science come to an abrupt end in a *revolution* phase—a crisis in which scientific *anomalies* of a time, unassailable by the paradigm of the day, come to seriously undermine the existing paradigm. For example, Maxwell's mathematical discovery of electromagnetic waves and continuous fields changed interpretations of reality based on the physics of material particles

in mechanical movement to one of waves and fields. The shift from one paradigm to another is disruptive rather than cumulative. The subsequent paradigm, in the example above, swept aside Newtonian theories. The observable and empirical approaches of Newtonian physics gave way to a new order of mathematics and postulations of the directly unobservable, like radio waves and the speed of light. The importance of this formulation is that paradigms are in Kuhn's view, incommensurable—meaning that there is little in common when it comes to measuring and assessing theories from different paradigms. Herein lies the rejection of scientific development as the cumulative building on earlier theories and, with each progressive theory, a closer approximation to scientific truth. In contrast with Popper's (1959) ideas of falsifiability, in which a good theory is one that can be refuted, Kuhn argued that the revolutionary phase is not a rational process. Rather, the revolutionary phase is wildly open to competition among different and incompatible ideas.

In design and HCI, the concept of paradigms is put to good use in Bødker's (2006) *When Second Wave HCI Meets Third Wave Challenges*. Bødker characterizes the development of the field of HCI as a succession of waves. In particular, she addresses the rise of a "third generation or wave, that one might identify as a break with the second wave, theoretically and technologically" (p. 1). She characterizes the second wave as HCI and design's focus on designing technologies in work settings for communities of practice. This wave opened design and HCI to sociological perspectives. Bødker identifies anomalies or unsolvable puzzles, to use Kuhn's terminology, in second wave HCI as challenges of a burgeoning third wave. These challenges are, broadly, the wider use contexts, applications, and settings for technology that moved beyond the workplace to homes and everyday settings. This shifted the concern of the field to cultural, emotional, and experiential aspects of technology and use. And in many respects, the challenges invert second wave concerns into matters of: "non-work, non-purposeful, non-rational, etc." (Bødker, 2006, pp. 1-2). A good example of the shift from second wave HCI is the *prayer companion* by Gaver et al. (2010). The *prayer companion* is a bespoke device in the form of a Tau cross that scrolls news items on a display to offer resources for prayer life of cloistered nuns. Attention here is given to exploring spiritual experiences through computation, rethinking broad categories of *aging or elderly*, and opening the design of digital artifacts to materiality, aesthetics, ambiguity, and interpretations of use.

The idea of second and third waves of HCI shows well the constructive nature of paradigms. Characterizing the field as successive waves, it describes new values and shifting foci without having to argue against progress or ideal truths. The incommensurability of paradigms is seen as a series of successive waves within the discipline, in which the latter wave replaces the previous wave. The incommensurability of paradigms holds the benefit of challenging humanist ideas of progress as ways of understanding disciplines. However, the successive winning out of a new dominant paradigm does little to shake free the disciplinary model of a foundational and territorial organization of thought and action. For a step in this direction, I turn to the idea of programs as developed by Redström (2017).

## Programs

In *Making Design Theory*, Redström (2017) addresses a central shortcoming of a disciplinary approach—foundational knowledge. He does this by arguing that the disciplinary foundation for design should be dynamic and transitional rather than stable. The key concept in this ongoing reflexive change in design is a *program*. In some respects, he normalizes the *revolution* phase of paradigms by adding the idea of programs as a purposeful and experimental mechanism for critical reflection on the foundations of a discipline. Programs are sets of beliefs and design ideals that encapsulate and foreground a particular worldview of designing. In this way, they can guide the design actions and thinking of designers within a program.

The real potential of programs is when there are multiple concurrent and competing programs operating within the discipline of design. This affords the possibility of looking at programs from the *outside*, as a matter of difference, in order to reflect on what else designing could be. It allows a form of meta-reflection that enables progressive change. A good example of a design research program is Redström and Hallnäs' work (2001) on *slow technology*. The worldview experimented with a what-if agenda, that designed technologies to create moments of reflection and mental rest rather than increasing performance and efficiency. The program continues through to recent work that emphasizes temporality and pace equally if not greater than functionality. For example, the *Photobox* by Odom et al. (2014) is an antique oak chest that encases a printer that randomly prints four or five photos a month from an owner's Flickr archive. The infrequency of a print, the lack of control by the user, and the fact that the photos are hidden from view make the experience of the technology one of anticipation, reflection, and surprise. Here, a program offers a vehicle for a purposeful and critical examination of foundational concepts for design, namely usability and productivity—through designing alternative *slow* technologies.

Redström adapts Lakatos' idea of *programme* (and changes the spelling to program), which was in part a response to Kuhn's paradigms (Lakatos, 1976). Lakatos' programme is meant to reconcile Popper's theory of falsifiability, discussed earlier, with Kuhn's (1962) less rational and more evolutionary idea of how competing theories lead to a new paradigm. In Lakatos' view, science is supported by collections of theories that individually may be proven false, but, as a collection, are in practice irrefutable until the whole collection is proven otherwise. This collection of theories forms a programme that is implied to be an evolving foundation for a new paradigm (Lakatos, 1976).

In Redström's hands, programmes go through a degree of radical change. He situates his adapted version of programs within the discipline of design as a mechanism to destabilize the discipline. This is in contrast to Lakatos, who saw change as a stepwise approach toward a unified foundation for science. Redström sees this stability as highly problematic for design and needing to be actively defended against. Stable theories are problematic because design is concerned with producing contingent and provisional knowledge in the form of *products, concepts, and structures* rather than laws and absolute measures. Redström argues that fluid and conflicting foundations are better for exploring possible realities

through design. With Redström, programs are assigned the role of experimenting with and generating alternatives that productively challenge and destabilize the discipline of design, as is the case with slow technology.

There is much that is valuable here for nomadic practices. Redström makes the difficult maneuver of adapting the epistemological language of natural sciences to design, which is a very necessary move for nomadic practices. Equally important is the concurrency of programs that creates a field of alternatives which may align or contradict in different ways. Redström applies this as a way to reflexively maintain a transitional theoretical foundation for a discipline. As I will explain later, an important feature of nomadic practices is the establishment of interweaving trajectories of design or distinct perspectives on what it is being designed, which extends Kuhn's incommensurability into parallel rather than sequential movements.

Programs are a step away from the disciplinary stasis of paradigms. The idea of transitional theoretical foundations unsettles the ground of design as a discipline, but does it go far enough? Redström keeps the notion of design as a discipline and a singular theoretical foundation however kept unstable. In further distancing from disciplinary structures to conceive of design, I look to Agre's (1997) concept of *generative metaphors* that eschews the paradigmatic idea of disciplinary foundations.

## Generative Metaphors

Agre (1997) develops the idea of generative metaphors to make the case for what he referred to as a *critical technical practice*. He argues that such a critical technical practice is necessary to shift from the underlying Cartesian rationalism in computer modelling and artificial intelligence (AI). Agre's idea of a critical technical practice implicitly draws on Kuhn's rejection of progress and ideal truths, but explicitly rejects Kuhn's disciplinary framing of paradigms and foundational knowledge:

A critical technical practice would not model itself on what Kuhn (1962) called *normal science*, much less on conventional engineering. Instead of seeking foundations it would embrace the impossibility of foundations, guiding itself by a continually unfolding awareness of its own workings as a historically specific practice. It would make further inquiry into the practice of AI an integral part of the practice itself. It would accept that this reflexive inquiry places all of its concepts and methods at risk. And it would regard this risk positively, not as a threat to rationality but as the promise of a better way of doing things (Agre, 1997, pp. 9-10).

In rejecting Kuhn's disciplinary thinking, Agre focuses on the idea of technical practice. A technical practice is understood as historically specific, rather than autonomous, as one might see a discipline. A technical practice is also concerned with *building* as a distinct activity, in the sense of making and constructing entities like software (Agre, 1997). The framing of concepts and methods, as practice, moves the discussion further from under the shadow of disciplinary science as the ultimate reference point for ways of knowing. The radical nature of critical technical practice is, as

Agre states, to commit to a reflexive inquiry around a practice. And further, this reflexivity is willing to scrutinize and jeopardize the very concepts and methods that make up the practice. In thinking about how to guide a reflexive inquiry of one's own practice, Agre develops the idea of *generative metaphors*.

Agre (1997) draws on Schön's (1984) idea of utilizing metaphors, the *stories* of a field that drive inquiries in research, as a way to understand the *social reality* of a given practice. For example, using the idea of a network of connections and nodes as a metaphor for society would be a generative metaphor. Agre describes a generative metaphor as "an open-ended mapping from one discursive domain to another (economics and physics, reproductive physiology and cultural gender roles, evolutionary biology and social structures), and a metaphor is 'generative' in the sense that a research community can extend its own discourse by carrying one element after another through the mapping" (p. 34). Generative metaphors cross the boundaries of *discursive domains*, like social sciences and computer science in the example above. They are orthogonal in that a metaphor can *carry* thoughts and actions across the various disciplines to extend a given discourse, for example network topologies as an analysis for social bonds.

Another idea that draws on Schön is that a generative metaphor mutually shapes what deserves attention within a practice and how that attention should be structured theoretically and methodologically. For example, Agre (1997) saw in cognitive science the generative metaphor of *mentalism*, in which the human mind acts like an internal information processor, computing stimuli and perceptive data to reason on external responses and behavioral actions in the world. The then current theoretical and methodological formulations of cognitive science were clearly structured by the metaphor of an interior computing mind. The greater concern for Agre was what future trajectory lay in store given the hold of this metaphor. In the mode of reflexive inquiry, he counters with a generative metaphor of *interactionism*—that is mutual involvement, participation, and reciprocal shaping between humans and their environment.

The mutual naming and framing of concerns by generative metaphors reveals how the selection of a metaphor for attention shapes the actions of those in the practice. The worldview of the generative metaphor is put into practice, so to speak, by determining what that practice is and what it will become, similar to Redström's programs. And, as Agre articulates, as a consequence any given generative metaphor places other concerns at the margins of the practice. In a cognitive science practice based on the *mentalist* metaphor, embodied and contextual concerns are set at the margins. Agre's real concern is that without a critical awareness of how generative metaphors work, what is at the margins remains invisible to the field, and hence no alternatives arise to shift a practice away from a problematic direction or eventual stasis and repeating of itself. Hence the need for a critical technical practice that is able to diagnose and deconstruct the underlying generative metaphor that "will have an utterly pervasive influence on the techniques, methods, and priorities of a field" (Agre, 1997, p. 47). The *modus operandi* of a critical technical practice is to provide alternative generative metaphors,

by starting with what is relegated to the margins, and then doing the hard work of developing new techniques, methods, and priorities that can enable a shift of concerns from margin to center.

The applicability of generative metaphors to design practice is evident in the work of Harrison, Tatar, and Sengers (2007) in “The Three Paradigms of HCI.” These authors use Agre’s (1997) approach to address many of the same issues in HCI that Bødker (2006) discusses in her paradigms of second and third waves. Notwithstanding the use of the word paradigm, Harrison and colleagues use generative metaphors as a way to articulate the state of HCI at the time and its possible future trajectory. They deconstruct the practices of HCI into different generative metaphors of interaction, allowing them to further analyze the field as different *centers* and *margins* of concerns. Based on this analysis, they argue for an intervention through a third generative metaphor of *situated perspectives*, in which situated and embodied interactions, which were formerly marginalized by metaphors of mind and information processing, take center stage. In this case, it is evident that the critical work of deconstructing dominant metaphors and the seeking of alternatives can begin with paying attention to what is marginalized within any generative metaphor of the practice. Further, as Harrison et al. make clear, multiple generative metaphors may co-exist signaling a potential plurality of practices. A recent example of this approach is *Being the Machine* or what is also known as *Redeform*, by Devendorf and Ryokai (2015). *Being the Machine* is a 3D printer in which the human user becomes in effect the printing head guided by a digital system. The system is a deconstruction of the dominant metaphor in digital fabrication of molding passive matter into an ideal abstract form represented in a computational model. Ingold (2011) views this approach as *hylomorphic*, a process that renders matter as inert and passive. In opposition, Devendorf and Ryokai (2015) adopt Ingold’s notion of the *non-hylomorphic* that sees materials and materiality as active and lively, equally shaping the fabricated form as a matter of process and flow.

The contributions of generative metaphors to the development of nomadic practices are substantial. Generative metaphors separate practices from foundational knowledge. Their own emergence is historical, and, in this sense, they inherit disciplinary practices without the structures. They argue that knowledge and methods are self-contained in practices. Lastly, generative metaphors can co-exist and operate across disciplines in ways that extend the discourse of a given practice and can be seen as nomadic.

## Toward a Posthumanist Epistemology for Design

Across paradigms, programs, and generative metaphors there are many characteristics and elements to build on in developing nomadic practices, especially by augmenting and refining these aspects through posthumanist commitments. Key among these elements is what I see as the making of practices, practices without foundations, and practices as transversals.

*Making of practices.* Agre (1997) is indebted to Schön’s (1984) definition of *practice*, as a form of knowledge production in its own right rather than an application of disciplinary

knowledge external to the practice. Schön famously argued that professions like engineering are reflective practices with their own epistemological and methodological grounding, rather than technical extensions of the disciplines of Physics and Mathematics. The distinct grounding of practices arises from their situated and embodied natures that privilege experiences and contexts over laws and principles. This relation to experience, makes the practitioner of the practices explicit. In Agre, this arose as the *naming and framing*, which Schön sees as the mutual shaping of the practice and practitioner, whereby what is attended to by a practitioner shapes the practice and in turn the practitioner.

*Practices without foundations.* Agre (1997) and Redström (2017) do the valuable and difficult work of adapting reconceptualizations of science to technical practices. In doing so, their formulations of practice take on a critical relation to the idea of foundations, the theoretical concepts and assumptions of a given practice. Redström’s program aims to destabilize the foundations of design, to keep theories and assumptions of a discipline in a transitional state. This, in Redström’s view, is a better fit with the contingent nature in which knowledge is produced in design. Agre eschews foundations and disciplines altogether to focus on practice. Practices in Agre are a social construction that can be continually deconstructed like a literary text. Like any text, a practice has a coherent story or a dominant narrative that can be undone by parts of the narrative that are excluded and put to the margins.

*Practices as transversals.* Redström and Agre take advantage of the incommensurability of Kuhn’s paradigm to emphasize pluralism and movement of competing notions of design. Redström describes programs as mechanisms to productively destabilize disciplines, keeping them from stasis. This destabilization is most effective when multiple programs co-exist in a critical relation to each other and the original foundations of design. Generative metaphors are freed from any relations to a foundation and so can also coexist. In place of foundations, they are structured as a dynamic of center and margins, in which the exclusionary force of the main metaphor creates alternatives at the margins of a practice. And, through critical intervention, what lies at the margins can eventually take center stage.

These aspects of making practices—practices without foundations, and practices as transversals—are elements to build on. However, there are shortcomings that will also need to be addressed. The mechanics of generative metaphors is center to margins, which creates a dualism that in many respects is unnecessary and potentially too reactive. Another shortcoming to address is that the multiplicity of programs and generative metaphors are a fixed and hierarchical relationship between critiques to foundation or margins to center. This type of fixed relationality is not, in a sense, relational enough.

## Intentionality, Situated Knowledge, and Nomadism in Nomadic Practices

In this section, I will introduce posthumanist concepts that will help shape this discussion further and set the theoretical scaffolding in place for nomadic practices. In particular, I will discuss the postphenomenological ideas of intentionality to support ideas of embodied variations (Verbeek, 2008). To draw out and make

good on the idea of a practice without foundations, Haraway's (1988) feminist perspective on objectivity and situated knowledge will be invaluable. And, to set the terms for a non-disciplinary structure, the element of practices of transversal opens the door to multiplicity and movement that can be further refined through Deleuze and Guattari's (1987) ideas of nomadism.

### Intentionality of Nomadic Practices

In phenomenological terms, humans, as a notion, cannot be seen in isolation but rather in relation to the world. Intentionality, in the phenomenological tradition of Husserl and Merleau-Ponty, is the central concept by which to understand the relationship between humans and their world (Verbeek, 2008). The importance here is that the way in which we are directed toward reality constitutes ourselves and the world together:

Humans are always directed toward reality. They cannot simply "think," but they always think *something*; they cannot simply "see," but they always see *something*; they cannot simply "feel" but always feel *something*. As experiencing beings, humans cannot but be directed at the entities which constitute the world. Conversely it does not make much sense to speak of "the world in itself" either. Just like human beings can only be understood from their relation with reality, so can reality only be understood from the relation human beings have with it. The "world in itself" is inaccessible by definition, since every attempt to grasp it makes it a "world for us," as disclosed in terms of specific ways of understanding and encountering it. (Verbeek, 2008, pp. 388-389)

Phenomenological intentionality is distinct from the more general meaning of intentionality, which is to form intentions or set goals. Rather, phenomenological intentionality illuminates the way experience is structured, through our embodiment, situatedness, and contingencies. This creates a relationality that shapes what we make of the world and in turn this experience shapes us. This shows intentionality to be bidirectional: The designer shapes the *something* designed as it in turn shapes the designer. Intentionality also reveals that the subject-object is not only mutually constituted but variant. In this way, designers are formed by what they design in ways that can vary; as such, however we constitute the designer, intentionality is not only relational, but composed of differences and differently structured experiences of the world.

The importance for nomadic practices is that we can begin to see practices like design as formed by different intentionalities that constitute different types of designers designing differently. In other words, we cannot see *designers* as simply *designing* but rather as designing *something*. Equally, we cannot see *design in itself* but rather only in relation to *designers designing something*. And that *something* is structured in different ways that are embodied, situated, and contingent—meaning that designers as well, as a matter of co-constitution, are also relational and multiple. Nomadic practices begin with the principle that designers and what is designed are multiply fashioned in numerous variations that are both coherent within and through intentionality.

### Situated Knowledge of Nomadic Practices

In my discussion of paradigms, programs, and generative metaphors, I hope to have mapped an alternate route around disciplinary structures toward a concept without foundations, hierarchies, and the claiming of territory for describing the variant knowings and actions of a given design. As discussed earlier (see *Background* section), disciplines operate within an illusion of a total and self-autonomous body of knowledge. Such a body is attended to by disciplinarians who occupy a seemingly objective and therefore a truly uninhabitable perch to police, govern, and monitor the foundations and perimeters of the discipline (see Krippendorff, 2016). Haraway (1988) famously and simply calls this a *god trick*. That is the *promising vision from everywhere and nowhere equally and fully*. She argues against the transcendent or objective models of knowing by offering a localized understanding of knowing referred to as *situated knowledge*. This is described as an embodied objectivity that is accountable by virtue of making clear that knowers are situated, in a particular and local position, relative to what is known and to other knowers. And this localized embodiment, the perspective of the knower, is reflected in the knowledge created and in *how* that knowledge is created. Situated knowledge makes unavoidable the limitations of knowing given the knowing subject in every case is a result of differences, contingencies, embodiments, and incompleteness, while, at the same time, these situated knowledges collectively form a *radical multiplicity* of knowledge.

Yet, not wanting to give in to relativism or give up on reality or the spirit of objectivity, Haraway (1988) positions an embodied and visible knower in place of an all-seeing invisible knower as a measure of credible knowledge. This turns objectivity into a matter of accountability. This accountability arises from the visible knower being made present in the process of knowing. Further, as a result of the perspectivism of the situated knower, an additional and necessary accountability comes into play, taking the responsibility that any interpretations of reality are partial and incomplete, and gaining trust by acknowledging this limitation. In situated knowledge, objectivity is not derived from neutrality in knowing. For Haraway and feminist thinking there is no desire for a *theory of innocent powers to represent the world*, a desire that marks humanist and masculine ideals of objectivity. Feminist objectivity, in this way, embraces knowing in its multiplicity:

Subjectivity is multidimensional; so, therefore, is vision. The knowing self is partial in all its guises, never finished, whole, simply there and original; it is always constructed and stitched together imperfectly, and therefore able to join with another, to see together without claiming to be another. Here is the promise of objectivity: a scientific knower seeks the subject position, not of identity, but of objectivity, that is, partial connection. There is no way to *be* simultaneously in all, or wholly in any, of the privileged (i.e., subjugated) positions structured by gender, race, nation, and class. (Haraway, 1988, p. 586)

Situated knowledge dismantles the assumption that through the rigors of technique and method, or conversely through the politics of identity, the all-seeing position is achieved and only



from this vantage point can claims be made on what is true and needs to be known. The assumption of who can claim to know is dismantled. In situated knowledge, the claim to know is not a privileged position but is privileged as the way to know: “So, with many other feminists, I want to argue for a doctrine and practice of objectivity that privileges contestation, deconstruction, passionate construction, webbed connections, and hope for transformation of systems of knowledge and ways of seeing” (Haraway, 1988, p. 584). And, within this multiplicity of limited and contradictory claims, there is the ability to *join with another*, or as Haraway puts it, a *positioned rationality*—which is “the joining of partial views and halting voices into a collective subjective position” (p. 590). Positioned rationality is not about resolution or *claiming to be another* but about making collective claims of knowing.

The importance of this discussion is that understanding design from the perspective of situated knowledge also opens design to being understood in multiplicity. The issue is not which claims are truer toward an ideal notion of design but rather that all claims about design that hold an embodied objectivity are accountable claims for what in a collective fashion—with all the contradictions and partial knowing intact—is a collective design. The value of the claims can be seen in the visions and productive interpretations of how we know and see design.

### Nomadism in Nomadic Practices

Nomadism is central to the idea of nomadic practices by supporting and pushing further the notion of practices as transversals. Up to this point, I have discussed the principle of intentionality as the binding of subject-object or designer-designed together in ways that not only structure what each means but which are open to a multiplicity of variations. Situated knowledge makes explicit the perspectivism behind ways of knowing. It also shows that this plurality of perspectives does not atomize the meaning of design into unrecognizable bits of relativism. Rather, through *positioned rationality* a collective subjective view of design emerges that accounts for the embodied knower or knowers of design. Yet in a design without foundations or fixed definitions, how do we understand what form these alternatives take and what features they hold?

To answer these questions, I draw on Deleuze and Guattari’s (1987) *nomadism*. They often speak of opposing poles on a spectrum including, for example, the territorialized and deterritorialized. Aldea (2014) concisely illustrates nomadism as a spectrum of orders between sedentary and nomadic:

Under the sedentary order, exemplified by the image of agricultural land, distinct parcels of land are distributed to determined groups of people. Areas of land are divided and demarcated, in order that the ownership of the land is clear. Any movement across sedentary land is defined by borders and boundaries: as you move from one distinct place to another, from field A to field B, roads and walls determine the route you have to take. In contrast, under the nomadic order, exemplified by the image of the desert, a number of people are scattered across an expanse of land, without clear borders or exclusive ownership. The route from point A to point B is not determined in the same way as under the sedentary order. Rather, stopping places are subordinated to the journey itself: meeting places, encampments, watering holes instead of fields, cities, castles.

Deleuze and Guattari (1987) use this language of territories and movement to describe an array of organizations from political systems to the military and to the sciences. Deleuze and Guattari offer an illustrative example by comparing the games of chess and Go (see Figure 1). Both are strategy games. Social structures of differentiated power are represented in the chess board pieces, including kings, queens, knights, and lowly serfs or pawns. The object of chess is to *kill* or remove your opponent’s pieces from the board. Go is abstract, without representations or structures, and so the pieces are typically either white or black. The aim of Go is to surround and occupy more territory than the other player.

The sedentary order in Deleuze and Guattari is typically associated with *the State* or organizational authority. Chess is a game of the State, not only historically but structurally as well. Chess pieces are, to use Deleuze and Guattari’s term *coded*, meaning they have intrinsic properties or an internal nature that defines them in terms of movements, actions, and capacities. These codes are unchangeable. For example, a knight piece is

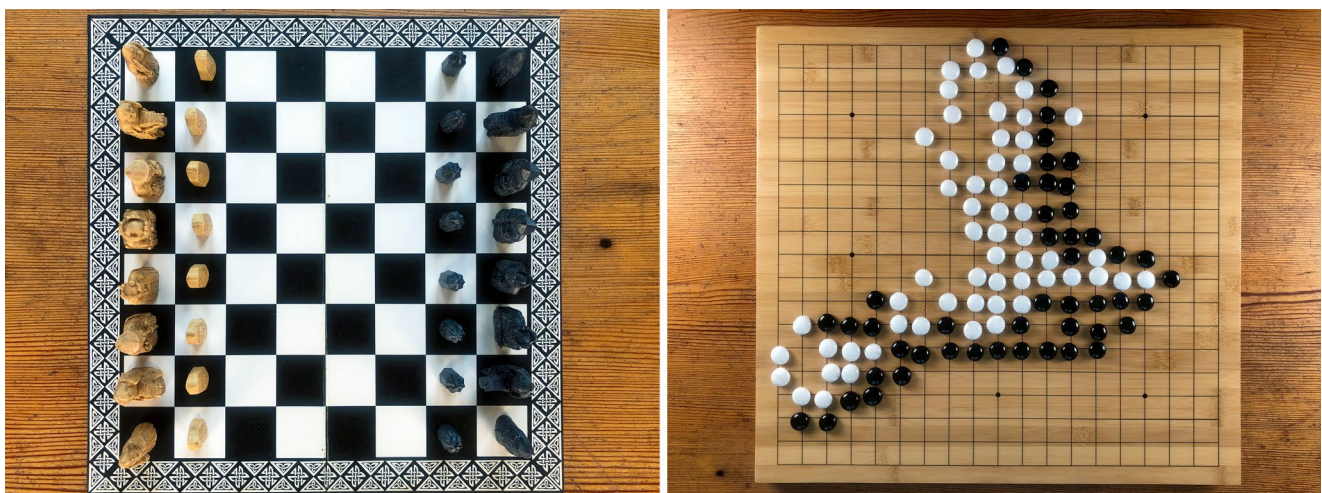


Figure 1. Chess board (left) and Go board (right).



intrinsically different from a queen, because the knight can move on the board in the shape of an *L*, whereas a queen can move in any straight line across the length of the board. A player is understood as the totality of all her pieces on the board. These pieces are part of a hierarchical organization, from pawns to king, and have power relative to their place in the hierarchy. This echoes the idea of agricultural land as sedentary, members of which are clearly divisible and accorded individual capacities. Even the board of chess is a matter of borders and boundaries divided between opponents down the center of the board. Go, a completely different strategy game, is what Deleuze and Guattari (1987) see as nomadic in its order. The pieces are “anonymous, collective, or third-person” (p. 352), featureless and non-referential. Typically, the pieces are either black or white stones or pellets, but in principle any two contrasting forms will do. Go pieces have no coded or intrinsic properties, only situational properties acquired externally through the placement of other Go pieces. This establishes a clear difference in gameplay where chess pieces are *structural*, posing threats to opponents in concert with other chess pieces and the positions of the opponents’ pieces. Go pieces are more nebulous, becoming parts of patterns and constellations. In the right circumstances, one Go piece can change the entire arrangement of the board and the game in a single move. Ultimately, as a war game, Deleuze and Guattari see chess as an “institutionalized, regulated, coded war with a front, a rear, battles”, whereas Go “is a war without battle lines, with neither confrontation nor retreat, without battles even” (Deleuze & Guattari, 1987, p. 353).

Deleuze and Guattari describe war machines (the military apparatuses of structures and strategies) and not just strategy games of war, as assemblages along the spectrum of sedentary and nomadic. More closely related to my aims of a non-disciplinary framing for design, Deleuze and Guattari describe sciences as sedentary and nomadic. Major science, what I have described as disciplinary, is sedentary. Minor science, what I have described as practices, is nomadic. Again, it is important to caution that this is a distinction on a spectrum rather than an explicit opposition, what DeLanda (2016) refers to as *parameters*, is a matter of emphasis, in one direction or another. Major science is axiomatic, producing laws and principles by which to question or investigate phenomena. Minor science follows phenomena, allowing the phenomena to pose problems. DeLanda details this distinction further:

Deleuze and Guattari include other characteristics of minor and major fields in addition to the contrast between the problematic and axiomatic approaches, and between the practice of following phenomena rather than interrogating them using predefined categories or laws. The authors [Deleuze & Guattari] argue that while minor science concerns itself with flows, major science treats fluids as a special case of a theory of solids; while minor science deals with becoming, major science concerns itself with what is stable, eternal, identical, and constant... (p. 96)

DeLanda (2016) expands on Deleuze and Guattari’s (2014) analysis of major and minor sciences in a case study of chemistry, that like most scientific fields aspires to the status of a major science,

all the while demonstrating the nomadic characteristics of a minor science. Here, I have expanded on this idea to make the point that nomadic practices will treat design as a minor science, emphasizing the nomadic parameter of pursuing phenomena to generate problems in ways that constantly move across territories, settling and unsettling (territorializing and deterritorializing in the language of Deleuze and Guattari), all the while avoiding laws, principles, foundations, territorial claims, and hierarchical structures.

Nomadism contributes centrally to the idea of nomadic practices, revealing an enabling approach to traverse across territories, avoiding disciplinary structures. Equally important, it moves to the fore the ongoing emergence of the phenomena of which a given design *follows* or *gathers* around. Lastly, it makes understanding a particular nomadic practice of design a matter of describing the relational features it holds.

## Nomadic Practices

At the risk of making the *destination* of the article seemingly abrupt in relation to the journey of getting here (though in keeping with the nomadic approach), I will end with a succinct description of the features of nomadic practices. Nomadic practices can be described as having three features:

- *Multiplicity of intentionalities* is the plurality with which designers and the *something* designed are mutually constituted across different nomadic practices. Nomadic practices are shared intentionalities in which designers gather around different ways to structure possibilities of designing.
- *Situated knowing* is the way knowledge of the particular *something* to design of nomadic practices is created. The knower or designer is embodied, situated, and made visible with respect to any claims of what is known about design. As a result, nomadic practices offer multiple ways to know design resulting in knowledge that is diverse and collective.
- The *nomadism* of nomadic practices refigures design from a single territorial discipline to a multiplicity of concurrent, allied, non-allied, collaborative, competitive, contradictory, or aligned practices of design marked by who gathers around a particular something to design. There is a plurality of gatherings that traverse across a landscape, territorializing and deterritorializing, as they go, following the somethings they design—wherever that may lead, often crossing paths to contest or form allegiances with other nomadic practices.

The accountability or credibility of nomadic practices is established in various ways. One is through the embodied objectivity of making visible the knower of the nomadic practice and the ways of knowing. Secondly, nomadism structures nomadic practices as gatherings of knowers/designers around a particular notion of design and its accompanying *something*. As a gathering, nomadic practices are accountable based on who and what they gather both in quantity and kind. Further, nomadic practices are much more fluid and dynamic than disciplines since they can grow or fade depending on the attraction to gather or not within a given shared intentionality.

To give up on a claim to universalism, as nomadic practices do, is to also abandon ideas of generalizable knowledge. In many respects, epistemological theories of design like conceptual constructs (Stolterman & Wiberg, 2010) or intermediate knowledge and strong concepts (Höök & Löwgren, 2012) have already argued against universal principles in exchange for propositional and materialist understandings of how design knowing is generated and shared. Nomadic practices take this a step further, and in doing so emphasize a collective approach to knowledge and its creation. Firstly, generative metaphors make clear that, regardless of how we may now reconceptualize design practices, we will have inherited a history of knowing that can be appropriated and above all else shared. However, this asserts the need to investigate historical narratives beyond the hegemonic as with the critical work of undoing long-silenced narratives of design (Rosner, 2018) or exposing the past racial encodings of technology (Benjamin, 2019). Moving forward, nomadic practices are dynamic and on the move such that their trajectories are defined by intersections, divergences, contestations, and temporary alliances with other nomadic practices in which knowing and know-how cross-pollinates and is shared. Thinking of knowledge collectively and shared across nomadic practices rather than an abstract and generalizable theoretical foundation for all practices, points to what Haraway refers to as a *radical multiplicity* of knowledge that is far richer and more diverse than a singular discipline (Haraway, 1988).

So, what can be done with nomadic practices? Elsewhere, I have explored in detail how nomadic practices can be used retrospectively to reconceptualize past design practices (Wakkary, 2021). Each of these practices is governed by different intentionalities and develops particular knowledge and know-how to sustain their practice. For example, the *nomadic practice of designing artifacts* describes the design researchers in HCI and participatory design that hold the shared intentionality of designing artifacts that contribute to human progress by supporting complex human use and considering social-psychological factors. I elaborate on how a social enterprise like the *Fairphone* is an artifact in that it strives for progressive human use and creation of technologies (Akemu et al., 2016). I also describe what I call the *nomadic practice of designing objects* in which designers are constituted as moralists who *design objects* based on ethical and aesthetic principles to attain a certain virtue through design that is normative or prescriptive. I discuss how Rams' design works like the Braun Pocket Receivers are a form of design asceticism in which Ram urges *as little design as possible* in order to create enduring goods of a higher order (Lovell et al., 2011). Nomadic practices reconfigure past affinities and associations in new ways such that speculative design like *Kar-a-sutra* by Bellini (1972), an unwavering critique of consumer capitalism, shares an intentionality with Rams and Braun products. Both design from a shared morality and prescriptive ideal of what a design object should be. Lastly, I describe the *nomadic practice of designing products* in which professional designers like UX designers at Facebook or product companies direct themselves at a commercial world in which products aim to serve the human economic goals

of fair transactions between profit and consumer satisfaction. These multiple framings of design are grounded in the idea of different ways of addressing the world through design or different intentionalities made up of differently constituted subject-objects of design. Nomadic practices show the possibility to design with important and central differences from other practices, and where there are commonalities these emerge not from a singular foundation but from ongoing cooperation, overlaps, and appropriations across each of the nomadic practices.

However, the point for me in theorizing nomadic practices is to create an epistemological opening for new ways of conceptualizing design. And, specifically, to do so by removing epistemological hurdles of humanist disciplines such that how we know design could be more expansive and diverse. My particular pursuit is to investigate a posthumanist design that runs counter to humanist ideals and the structures that support them. I refer to this as *nomadic practice of designing things* in which I investigate a practice of design to better cohabit our world with species and matter that are not human. I describe things—nonhumans made by designers—that are agentic and vital and so capable on the one hand of transforming the world on their own and on the other hand contribute as a nonhuman designer together with humans. The nomadic practice I explore here is one in which human designers are entangled with nonhuman designers to design things with humility in an approach I call *designing-with* (Wakkary, 2021).

The aim of this article is to see design in expansive terms as I described above and to invite others to critically imagine, assemble, and act through other nomadic practices. The hope is that through the removal of epistemological barriers set by seeing design as a humanist discipline, we can collectively engage design as a plurality of intentionalities that include decolonizing worlds, multi-species relations, technofashion, critical-zone networks, racial justice policies, and countless others.

In conclusion, the theory of nomadic practices has a particular and pragmatic role to play in my research. I use it as an intellectual argument to pry open space to discuss a shared intentionality of design that is not afforded in humanist notions of disciplines. The article traces related approaches including paradigms, programs, and generative metaphors and draws from these in combination with posthuman commitments of phenomenological intentionalities, situated knowledge, and nomadism to develop a theory of nomadic practices. The aim of this work is to find an alternative structure to a humanist discipline for design such that design practices can be seen as relational, expansive, and plural.

## Acknowledgements

I am indebted to a great number of colleagues and friends who reviewed versions of this draft in its book form and in preparation for this article, including Gabriela Aceves Sepúlveda, Tamara Alvarez, Alissa Antle, Audrey Desjardins, Laura Devendorf, Laura Forlano, Cindy Lin, William Odom, James Pierce, Robert Rosenberger, Oscar Tomico, Peter-Paul Verbeek, MIT Press, and *International Journal of Design* anonymous reviewers, all of whom

offered invaluable feedback. I especially want to thank those I work with in the Everyday Design Studio who scrutinized and critiqued this text with me, namely Doenja Oogjes, Armaghan Behzad Behbahani, Xiao Zhang, Jordan Eshpeter, Ce “Kimi” Zhong, Henry Lin, Tiffany Wun, Nico Brand, Min Young, and Jordan White. I also thank the Social Sciences and Humanities Research Council (SSHRC) and the Natural Sciences and Engineering Research Council (NSERC) of Canada for funding this research.

## Endnotes

1. This article is an adaptation of the “Nomadic Practices” chapter in Wakkary’s (2021) book, *Things we could design: For more than human-centered worlds* (Ch. 2). <https://mitpress.mit.edu/books/things-we-could-design>

## References

1. Agre, P. E. (1997). *Computation and human experience*. Cambridge, UK: Cambridge University Press.
2. Akemu, O., Whiteman, G., & Kennedy, S. (2016). Social enterprise emergence from social movement activism: The Fairphone case. *Journal of Management Studies*, 53(5), 846-877.
3. Aldea, E. (2014). *Nomads and migrants: Deleuze, Braidotti and the European union in 2014*. Retrieved from <http://www.opendemocracy.net/can-europe-make-it/eva-aldea/nomads-and-migrants-deleuze-braidotti-and-european-union-in-2014>
4. Andersen, K., Wakkary, R., Devendorf, L., & McLean, A. (2019). Digital crafts-machine-ship: Creative collaborations with machines. *Interactions*, 27(1), 30-35.
5. Bellini, M. (1972). Kar-a-sutra. In E. Ambasz (Ed.), *Italy, the new domestic landscape* (pp. 200-210). New York, NY: Museum of Modern Art.
6. Benjamin, R. (2019). *Race after technology: Abolitionist tools for the New Jim Code* (1st ed.). Cambridge, UK: Polity.
7. Bødker, S. (2006). When second wave HCI meets third wave challenges. In *Proceedings of the 4th Nordic Conference on Human-computer Interaction* (pp. 1-8). New York, NY: ACM.
8. Bostrom, N. (2005). A history of transhumanist thought. *Journal of Evolution and Technology*, 14(1), 1-25.
9. Braidotti, R. (2012). *Nomadic theory: The portable Rosi Braidotti*. New York, NY: Columbia University Press.
10. Braidotti, R. (2013). *The posthuman*. Cambridge, UK: Polity.
11. Cross, N. (2006). *Designerly ways of knowing*. London, UK: Springer-Verlag London.
12. DeLanda, M. (2016). *Assemblage theory*. Scotland, UK: Edinburgh University Press.
13. Deleuze, G., & Guattari, F. (1987). *Thousand plateaus: Capitalism and schizophrenia* (2nd ed.). Minneapolis, MN: University of Minnesota Press.
14. Devendorf, L., De Kosnik, A., Mattingly, K., & Ryokai, K. (2016). Probing the potential of post-anthropocentric 3D printing. In *Proceedings of the Conference on Designing Interactive Systems* (pp. 170-181). New York, NY: ACM.
15. Devendorf, L., & Ryokai, K. (2015). Being the machine: Reconfiguring agency and control in hybrid fabrication. In *Proceedings of the 33rd Conference on Human Factors in Computing Systems* (pp. 2477-2486). New York, NY: ACM.
16. DiSalvo, C., & Lukens, J. (2011). Nonanthropocentrism and the non-human in design: Possibilities for designing new forms of engagement with and through technology. In L. Forlana, M. Foth, C. Satchell, & M. Gibbs (Eds.), *From social butterfly to engaged citizen: Urban informatics, social media, ubiquitous computing, and mobile technology to support citizen engagement* (pp. 440-460). Cambridge, MA: MIT Press.
17. Encinas, E., Durrant, A. C., Mitchell, R., & Blythe, M. (2020). Metaprobes, metaphysical workshops and sketchy philosophy. In *Proceedings of the Conference on Human Factors in Computing Systems* (pp. 1-13). New York, NY: ACM.
18. Escobar, A. (2018). *Designs for the pluriverse: Radical interdependence, autonomy, and the making of worlds*. London, UK: Duke University Press.
19. Frauenberger, C. (2019). Entanglement HCI the next wave? *ACM Transactions on Computer-Human Interaction*, 27(1), Article 2. <https://doi.org/10.1145/3364998>
20. Fry, T. (1999). *New design philosophy: An introduction to defuturing* (1st ed.). Sydney, Australia: University of New South Wales Press.
21. Gaver, W., Blythe, M., Boucher, A., Jarvis, N., Bowers, J., & Wright, P. (2010). The prayer companion: Openness and specificity, materiality and spirituality. In *Proceedings of the Conference on Human Factors in Computing Systems* (pp. 2055-2064). New York, NY: ACM.
22. Giaccardi, E., Cila, N., Speed, C., & Caldwell, M. (2016). Thing ethnography: Doing design research with non-humans. In *Proceedings of the Conference on Designing Interactive Systems* (pp. 377-387). New York, NY: ACM.
23. Hallnäs, L., & Redström, J. (2001). Slow technology: Designing for reflection. *Personal Ubiquitous Computing*, 5, 201-212.
24. Haraway, D. (1988). Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist Studies*, 14(3), 575-599.
25. Harrison, S., Tatar, D., & Sengers, P. (2007, May 1). *The three paradigms of HCI*. Paper presented at the SIGCHI Conference on Human Factors in Computing Systems (alt. chi session), San Jose McEnery Convention Center, San Jose, CA. Retrieved from <http://people.cs.vt.edu/srh/Downloads/TheThreeParadigmsofHCI.pdf>
26. Hauser, S. (2018). *Design-oriented HCI through postphenomenology* (Doctoral dissertation). Simon Fraser University, Burnaby, Canada.
27. Hauser, S., Oogjes, D., Wakkary, R., & Verbeek, P. -P. (2018). An annotated portfolio on doing postphenomenology through research products. In *Proceedings of the Conference on Designing Interactive Systems* (pp. 459-471). New York, NY: ACM.
28. Hayles, N. K. (1999). *How we became posthuman: Virtual bodies in cybernetics, literature, and informatics* (1st ed.). Chicago, IL: University of Chicago Press.

29. Höök, K., & Löwgren, J. (2012). Strong concepts: Intermediate-level knowledge in interaction design research. *ACM Transactions on Computer-Human Interaction*, 19, Article 23.
30. Ingold, T. (2011). *Being alive: Essays on movement, knowledge and description*. London, UK: Routledge.
31. Krippendorff, K. (2006). *The semantic turn: A new foundation for design*. Boca Raton, FL: CRC Press.
32. Krippendorff, K. (2016). Design, an undisciplinable profession. In G. Joost, K. Bredies, M. Christensen, F. Conradi, & A. Unteidig (Eds.), *Design as research. Positions, arguments, perspectives* (pp. 197-206). Basel, Switzerland: Birkäuser Verlag/De Gruyter.
33. Kuhn, T. S. (1962). *The structure of scientific revolutions*. Chicago, IL: University of Chicago Press.
34. Kurzweil, R. (2000). *The age of spiritual machines: When computers exceed human intelligence*. New York, NY: Penguin Books.
35. Lakatos, I. (1976). Falsification and the methodology of scientific research programmes. In S. G. Harding (Ed.), *Can theories be refuted? Essays on the Duhem-Quine thesis* (pp. 205-259). Berlin, Germany: Springer.
36. Leahu, L. (2016). Ontological surprises: A relational perspective on machine learning. In *Proceedings of the Conference on Designing Interactive Systems* (pp. 182-186). New York, NY: ACM.
37. Light, A., Powell, A., & Shklovski, I. (2017). Design for existential crisis in the anthropocene age. In *Proceedings of the 8th International Conference on Communities and Technologies* (pp. 270-279). New York, NY: ACM.
38. Lindley, J., Coulton, P., & Cooper, R. (2017). Why the Internet of Things needs object orientated ontology. *The Design Journal*, 20, S2846-S2857. <https://doi.org/10.1080/14606925.2017.1352796>
39. Liu, S.-Y. (Cyn), Bardzell, J., & Bardzell, S. (2018). Photography as a design research tool into natureculture. In *Proceedings of the Conference on Designing Interactive Systems* (pp. 777-789). New York, NY: ACM.
40. Lovell, S., Kemp, K., & Ive, J. (2011). *Dieter Rams: As little design as possible*. New York, NY: Phaidon Press.
41. Moravec, H. P. (1999). *Robot: Mere machine to transcendent mind*. Oxford, UK: Oxford University Press.
42. Odom, W. T., Sellen, A. J., Banks, R., Kirk, D. S., Regan, T., Selby, M., ... Zimmerman, J. (2014). Designing for slowness, anticipation and re-visitation: A long term field study of the photobox. In *Proceedings of the Conference on Human Factors in Computing Systems* (pp. 1961-1970). New York, NY: ACM.
43. Oogjes, D., & Wakkary, R. (2017). Videos of things: Speculating on, anticipating and synthesizing technological mediations. In *Proceedings of the Conference on Human Factors in Computing Systems* (pp. 4489-4500). New York, NY: ACM.
44. Pierce, J., & Paulos, E. (2013). Electric materialities and interactive technology. In *Proceedings of the Conference on Human Factors in Computing Systems* (pp. 119-128). New York, NY: ACM.
45. Pilsch, A. (2017). *Transhumanism: Evolutionary futurism and the human technologies of utopia*. Minneapolis, MN: University of Minnesota Press.
46. Popper, K. (1959). *The logic of scientific discovery* (2nd ed.). London, UK: Routledge.
47. Redström, J. (2017). *Making design theory*. Cambridge, MA: MIT Press.
48. Rosner, D. K. (2018). *Critical fabulations: Reworking the methods and margins of design*. Cambridge, MA: MIT Press.
49. Schön, D. A. (1984). *The reflective practitioner: How professionals think in action* (1st ed.). New York, NY: Basic Books.
50. Smith, N., Bardzell, S., & Bardzell, J. (2017). Designing for cohabitation: Naturecultures, hybrids, and decentering the human in design. In *Proceedings of the Conference on Human Factors in Computing Systems* (pp. 1714-1725). New York, NY: ACM.
51. Stolterman, E., & Wiberg, M. (2010). Concept-driven interaction design research. *Human-Computer Interaction*, 25(2), 95-118.
52. Van Dongen, P. (2019). *A designer's material aesthetics reflections on fashion and technology*. Eindhoven, the Netherlands: Artez Press.
53. Verbeek, P. -P. (2008). Cyborg intentionality: Rethinking the phenomenology of human technology relations. *Phenomenology and the Cognitive Sciences*, 7(3), 387-395.
54. Verbeek, P. -P. (2011). *Moralizing technology: Understanding and designing the morality of things*. Chicago, IL: University of Chicago Press.
55. Wakkary, R. (2021). *Things we could design: For more than human-centered worlds*. Cambridge, MA: MIT Press.
56. Wakkary, R., Oogjes, D., Hauser, S., Lin, H., Cao, C., Ma, L., & Duel, T. (2017). Morse things: A design inquiry into the gap between things and us. In *Proceedings of the Conference on Designing Interactive Systems* (pp. 503-514). New York, NY: ACM.
57. Wakkary, R., Oogjes, D., Lin, H. W. J., & Hauser, S. (2018). Philosophers living with the tilting bowl. In *Proceedings of the Conference on Human Factors in Computing Systems* (Article No. 94). New York, NY: ACM.
58. Wiltse, H., & Stolterman, E. (2010). Architectures of interaction: An architectural perspective on digital experience. In *Proceedings of the 6th Nordic Conference on Human-Computer Interaction* (pp. 821-824). New York, NY: ACM.