

Expanding Modes of Reflection in Design Futuring

Sandjar Kozubaev¹, Chris Elsdén², Noura Howell³, Marie Louise Juul Søndergaard⁴,
Nick Merrill³, Britta Schulte⁵, Richmond Y. Wong³

¹Georgia Institute of Technology, skozubaev3@gatech.edu

²University of Edinburgh, celsden@ed.ac.uk, ³University of California - Berkeley,

N. Howell: noura@berkeley.edu, R.Y. Wong: richmond@ischool.berkeley.edu, N. Merrill: ffff@berkeley.edu

⁴KTH Royal Institute of Technology, mljso@kth.se

⁵University College London, britta.schulte.15@ucl.ac.uk

ABSTRACT

Design futuring approaches, such as speculative design, design fiction and others, seek to (re)envision futures and explore alternatives. As design futuring becomes established in HCI design research, there is an opportunity to expand and develop these approaches. To that end, by reflecting on our own research and examining related work, we contribute five modes of reflection. These modes concern formgiving, temporality, researcher positionality, real-world engagement, and knowledge production. We illustrate the value of each mode through careful analysis of selected design exemplars and provide questions to interrogate the practice of design futuring. Each reflective mode offers productive resources for design practitioners and researchers to articulate their work, generate new directions for their work, and analyze their own and others' work.

Author Keywords: Design futuring; futures-oriented design; speculative design; research through design; futures; design methods.

CSS Concepts

• **Human-centered computing–Human computer interaction (HCI); Interaction design; Interaction design theory, concepts and paradigm.**

INTRODUCTION

In recent years, the HCI design research community has engaged a range of approaches to investigate and articulate different futures. This interest stems both from a lineage of reflective and radical practices in design, as well as more recent manifestations, variations and progressions such as critical design [29], speculative design [30], adversarial design [27], discursive design [95], design fiction [12] and others. Within HCI, these research programs have flourished amid a broader interest in using design methods to explore critical alternatives to dominant frameworks of meaning, particularly under growing concerns about environmental,

social, and economic costs of technology in global capitalism [35, 49, 56].

As these varied approaches to *design futuring* gain prominence in HCI, it is timely to consider the methodological and theoretical challenges they pose. While aspirations of these approaches are often emancipatory, critical and reflective, we find it can be difficult to articulate the claims of such work and appreciate its distinct contributions. At other times, design futuring can be inattentive to its own biases or, at worst, elitist. Further, it can be unclear how speculation or envisioning is positioned to engage with and intervene in the real world. Issues such as these motivated the authors of this paper—all of whom have practiced and are invested in design futuring—to collaboratively reflect on their own and others' work.

This paper contributes a set of resources we call '*reflective modes*', intended to help HCI researchers improve the quality and accountability of design futuring work. They are:

1. Designerly formgiving, its specificity and experiential qualities
2. Attending to temporal representations
3. Positionality: futuring from somewhere
4. Engaging with the real world
5. How design futuring generates new knowledge.

It is important to note that these reflective modes are resources, not standards or norms. Rather, their main purpose is to help design futuring researchers (i) analyze strengths and limitations of their own work and the work of others (ii) articulate their work or reframe it in new ways and (iii) generate new work. By proposing these modes, we aim to open a dialogue with the HCI design community to broaden and strengthen the quality and diversity of research involving design futuring methods.

BACKGROUND

Design research has explored and critiqued alternative futures through various practices, such as speculative design, design fiction, material speculations and others. These approaches remain varied and emergent, though they have gained prominence as third-wave HCI research takes on broader societal considerations [35, 49, 56]. In addition to dedicated tracks on Future Scenarios at NordiCHI and Design Fictions at GROUP, more design futuring papers are contributed to CHI every year. We refer to such approaches collectively as

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

CHI 2020, April 25–30, 2020, Honolulu, HI, USA.

© 2020 Copyright is held by the owner/author(s). Publication rights licensed to ACM. ACM ISBN 978-1-4503-6708-0/20/04...\$15.00.

DOI: <https://doi.org/10.1145/3313831.3376526>

'design futuring' throughout this paper. We note this term has been elsewhere [38]. While Fry used the term *design futuring* in arguing that the conception of design must shift to address pressing sustainability issues, we use it an umbrella term to refer (albeit loosely) to a variety of approaches that leverage design to explore futures as a means to comment on—and potentially change—the present. Other terms, such as discursive design, have also been used to collectively refer to future-oriented and speculative methods as a design space [95]. In using *'design futuring'*, we foreground key characteristics shared across a variety of approaches. First, in design futuring, design is not used to solve an immediate problem, but rather to produce knowledge through debate, contestation, reflection *etc.* Second, design futuring is concerned with future alternatives that differ, often radically so, from today. Crucial here is the active engagement with and questioning of what the future could be (implicitly or explicitly), and how it provides an alternative to the present.

Design Futuring in HCI

We begin by outlining prominent approaches to design futuring to highlight the variety of approaches and outputs.

Speculative Design and Design Fiction

There is a variety of futuring approaches [2, 3] and the field is highly contested. For brevity, we focus on two prominent approaches within HCI. Speculative design seeks to “open up all sorts of possibilities that can be discussed, debated, and used to collectively define a preferable future” [30]. In the style of Dunne & Raby, this often but not always, takes the form of polished physical artifacts. They invite the audience to imagine particular worlds where these artifacts are used in everyday life, while being presented in a gallery-like setting.

Design fiction helps imagine (future) story worlds through world-building [25, 57] or “making things that tell stories” [12]. A narrative element has been called essential to design fiction [62, 94]. For example, Schulte *et al.* propose *'design fiction probes'* to elicit participants' critical reflection on fictional technologies [84], while Kozubaev proposes using fictional artifacts in public spaces for this [51]. Within HCI, design researchers employ these approaches to explore potential implications of new technologies [15, 58, 101]; or to better communicate implications to various audiences recalling a tradition of scenario-based design [13, 21].

Notably, both speculative design and design fiction empower the designer or researcher to envision particular futures which are presented discursively for an audience to stimulate imagination and debate.

Performance, Enactment and Experience

Rather than merely presenting to an audience, Candy & Dunagan's body of work championed *'experiential futures'* [20], where designers and researchers seek to bridge the *'experiential gulf'* participants may feel in considering futures. HCI has a lineage of performative and experiential approaches to engage participants in speculation. Benford *et al.* collaborated with performance artists at Blast Theory to

invite participants into live and exhilarating performances [8–10]. Odom *et al.* and Elsdon *et al.* [31, 75] practice *'enactments'* where participants encounter carefully designed scenarios, probes, props and services, to prompt reflection on various futures. Wakkary *et al.*'s *'material speculations'* use *'counterfactual artifacts'*, situated in people's homes and everyday experiences, to conceptually open up possible worlds [99]. HCI researchers turning to these approaches tend to adopt a more empirical stance, where design futuring offers insight into the lived experience of upstream technologies.

Design Futuring Beyond HCI

The above-mentioned approaches are also practiced outside academia, e.g. by design agencies such as Extrapolation Factory, Superflux and Design Friction; and play a role in governmental policy-making [91] and technology industry [81]. Moreover, design futuring is not limited to these codified practices, but extends various interdisciplinary approaches, interweaving fields such as anthropology, science fiction, and feminist technoscience. Examples are design anthropological futures [88] or speculative fabulations that, following Haraway, offer a way of *'staying with the trouble'* in imagining still possible futures [42, 64].

Framing Design Futuring

We also draw from other scholarly traditions that focus on temporality and futures, in particular, futures studies and science and technology studies (STS). For an HCI audience, these traditions surface useful nuances of how futures are framed.

Futures studies offers conceptual resources on the epistemology and sociology of the future. This interdisciplinary field emphasizes continuous generation, examination, and evaluation of alternatives and avoids predictions [7, 82, 85]. Use of the term *'futures'* over *'the future'* in this field is emblematic of this emphasis. This framing helps push back against dominant narratives of technological *'progress'* that typically frame technological *'advances'* as an inevitable single path *'forward'* [86]. Though ideas about the future may seem intangible, they can have tangible real-world impact. For example, Weiser's ubiquitous computing vision [100] continues to influence the field of ubiquitous computing research, and the type of work that gets presented at the Ubicomp conference. Ubiquitous computing has faced serious critiques [6, 79] and is only one of many possible future visions.

Future studies also offers critiques of tendencies to project futures as either utopian or dystopian [19]. These *"hyperbolic narratives muddle the banality of more probable outcomes (positive and negative)"* [101]. Designers can help envision futures in more experiential detail [19]. This call for designerly engagement was made in response to the tendency in futures studies of relying on highly analytical and rationalistic ways of understanding futures, with methods such as scenario planning or the Delphi method, stemming from future studies' partly military origins [52]. Design and

futures studies continue to influence each other, and conceptual resources and analytical frameworks, such as the futures cone (see Figure 1) [98], are being taken up in design futuring.

STS literature underscores the importance of how futures are framed. Textual representations of the future can [67] shape ideas about risk, uncertainty, likelihood etc. Furthermore, ideas about the future can form ‘*socio-technical imaginaries*’ [47] and ‘*anticipatory regimes*’ [1] that influence how visions of the future are prioritized and what resources are mobilized to deal with them. Hence, how futures are framed, and how designers choose to envision or help others envision the future, has important social consequences.

METHOD: OUR APPROACH TO REFLECTION

For transparency and to invite continuing dialogue, we present our approach to reflection; how the authors came together to suggest modes for reflecting on design futuring.

Who we are and why we future

We are a group of design researchers who engage in design futuring with different points of entry, practices, and ends. We know each other through engaging with one another’s work and meeting at conferences. From different institutions and continents, and from different stages in our careers, we came together around a common interest in how our designs and research engage design futuring.

Our backgrounds in design futuring include: written and video design fiction critically reimagining futures of living with technology far into the future; designed artifacts and situations to invite people to experience near-future possibilities with technology; in-home artifact deployments to situate reflection in everyday life; design thinking exercises with community stakeholders to probe security and social justice issues; and media analysis of technology concept videos [31, 34, 46, 51, 84, 89, 101, 102].

While highlighting disciplinary diversity, we acknowledge our positionality and privilege. We are all based at Western research universities in the US, UK and Europe, who could afford to attend CHI and other HCI conferences in recent years. We all have some degree of racial privilege, relative to the community of HCI researchers. We acknowledge this here in order to continue to be cognizant of ongoing structural limitations in who gets to future [76] and to undergird our reflections (presented later) on the positionality and situatedness of design futuring.

In contributing these higher-level reflections, we draw from other papers that have taken similar approaches in contributing resources for reflection. These include different approaches to criticality in design [76], conceptual lenses to reframe approaches to emotional biosensing [46] and uses of envisioning in ubiquitous computing [79]. We draw on these and particularly on Brown *et al.* who provide ethical provocations for HCI “not as guidelines or recommendations but as instruments for challenging our views” [18]. We

contribute reflective modes as resources to help analyze, articulate, and generate design futuring work.

Process

Our process combines reflection on our own research practices with an intentionally partial literature review. Although we have published design futuring work in top HCI venues over the past several years, in reflecting we critically analyzed strengths and shortcomings of our own works, as well as the differences in our approaches, as a means to better articulate how design futuring operates. Rather than conducting a full literature review to make simply representative claims about design futuring, we instead reflected on what we see as influential threads of thought in design futuring research. Our goal was to address what we see as a need in HCI for more resources for conducting (and assessing) futures-oriented research in more robust, diverse, and reflexive ways.

First, we individually contributed a curatorial literature review of about ten works that influenced our own approach. In trying not to overlap with others’ selections, we each highlighted our individual approach. Discussing our selection of citations with the group emphasized the diversity of backgrounds that we all brought to design futuring research, including futures studies, cybersecurity, engineering, graphic design, STS, participatory design, action research, media studies, and science fiction studies.

Second, we each individually drafted high level reflections stemming from our discussion. At this point in the process we deliberately took risks in sketching out unfamiliar or potentially controversial or provocative ideas. We discussed our reflections within the group and clustered them into encompassing approaches and arguments. By considering each of these reflections against a number of exemplary works, we subsequently developed our individual reflections into the ‘modes’ or lenses of reflection presented below.

Finally, we iteratively took on writing sections of the paper, interspersed with team discussions over the course of several months. We sought to both define each reflective mode and make them productive and actionable resources for the HCI community.

REFLECTIVE MODES IN DESIGN FUTURING

We propose five reflective modes. They are neither collectively exhaustive nor mutually exclusive. We acknowledge that these modes draw from existing methods and approaches, which are already widely practiced within and outside of HCI. However, we argue that each of these modes can serve as resources for design futuring researchers: The reflective modes can help articulate and explain researchers’ own work. They can be generative—spurring new research questions and ways of practicing design futuring. Finally, they can serve as analytical tools—helping researchers analyze design futuring work to more rigorously evaluate knowledge contributions and limitations of this work.

In the following subsections, we elaborate each reflective mode's rationale and background, illustrate the use of the reflective mode in analyzing selected design exemplars, and propose initial questions that can help researchers engage in each mode.

Reflective Mode 1: Designerly Formgiving, Its Specificity and Experiential Qualities

Design as a process of material formgiving both creates and chooses what not to create. We reflect on how design's specific and experiential qualities strategically both '*close down*' and '*open up*' thinking about the future. We call for design futuring researchers to carefully consider how their designerly formgiving strategically opens and closes thinking about futures. Why did researchers craft a particular design for envisioning a future, and why did they craft it in this particular way? We argue design futuring researchers should reflect on design decisions in terms of how specific design artifacts shape thinking about futures.

Specificity

Part of design's power and effectiveness in design futuring comes from its specificity. Design allows for exploration of the particular [92]. By depicting or creating '*entry points*' [25] into a particular story world, creating a specific artifact, or structuring participation in an experiential scenario, designs help imagine a particular future.

For example, Wong *et al.* present an online forum question and answer (Q&A) about an API for a brain-computer interface [101]. The design artifact is in some sense small and closed, detailing text of a software developer's question, answers by others, and the querent's responses. As a diegetic prototype [50], the specific design artifact gestures toward the surrounding world required to make this exchange possible. The design illustrates a software developer's nascent ethical concerns, around applying a brain-computer interface to abusive content moderation, getting side-swept by prioritizing technical functionality. Why did the design researchers choose this way of envisioning a future, and why this particular future? The particular imagined future combines issues around brain-computer interfaces and content moderation labor, a relatively unique choice. Giving form to this future via a forum Q&A frames ethical considerations as situated in technical practice. Attention to materials used, choices of what to depict (or not), and the politics of those choices resulted in, rather than a generic scenario, a depiction of a particular set of actions situated in the fictional world, giving insight into the technological, cultural, and political assemblages in that world.

Design '*closes down*' thinking about futures by focusing on a specific imagined future. A design artifact is like placing a dot on the futures cone, investigating one particular spot in great detail. Yet, by fixing this dot a richness of detail '*opens up*', and engaging with that specificity allows imagining and evaluating what might be preferable or problematic futures. Even as a design artifact '*closes down*' possibilities, it '*opens*

up' space for discussion. A single design artifact can open discussion of multiple viewpoints.

Experiential

Designing in tangible, embodied, material ways helps think about futures more experientially and viscerally, responding to calls by Candy & Dunagan for designers to help bridge the '*experiential gulf*' between present and future [20]. Engaging not only analytical reasoning, but also emotional and embodied ways of knowing, can often better illuminate what futures might be possible, preferable or problematic.

For example, the Hawkeye probe, "*an interactive experience of a smart home system designed for dementia care*" [68], was deployed in eight participant homes for three weeks. With a control panel and product brochure, participants experienced playing the role of caregiver for a fictional woman with dementia living in a smart home. The design probes emotional and relational considerations surrounding surveillance-as-care. More so than with an abstract scenario, participants grappled with specific emotionally charged ethical considerations of surveillance, privacy, agency, and personal touch in caregiving.

Designing experientially for futures enacts a double '*closing down*' and '*opening up*'. Imagining a future in enough closed-down specificity that we can grasp and experience aspects of it in the present moment, while also opening up to divergent experiences and reactions of the design artifact in use. Returning to Candy, this helps "*bridge the experiential gulf between inherently abstract notions of possible futures, and life as it is apprehended, felt, embedded and embodied in the present and on the ground*" [20].

Focusing on particulars of envisioned futures provides a way to move beyond utopian and dystopian futures [19]. Designing physical and digital, discursive, and experiential artifacts allows the depiction and exploration of futures that focus on the '*in between*' of dystopia and utopia, understanding future worlds from multiple points of view situated in the everyday and mundane. These practices of '*closing down*' and '*opening up*' worlds in between dystopia and utopia recognize that the ways that people interact with technologies are heterogenous, diverse, and experienced through a range of feeling and emotion; futures should represent this diversity of experience as well.

Giving form to a specific story world, designing an experience, designers can help envision a particular future. To thoughtfully leverage design's specificity and experiential qualities to envision futures, we suggest design researchers consider these questions throughout their process and in reporting their work.

- Why did the design researchers choose this way of envisioning a future, and why this particular future?
- How do the particularities of the specific design artifact (object, narrative, experience, etc.) contribute to shaping an imagined future?

- How do designerly choices of materials and forms open and close particular futures for particular audiences?

Reflective Mode 2: Attending to Temporal Representations

This reflective mode attends to material, mental and social representations of the future and how they shape design futuring. Drawing on research from STS and anthropology, we argue that specific temporal representations influence specific framings of the future and researchers' and participants' subject positions towards it.

To conceptualize futures, HCI designers and researchers can use heuristics or visual representations of time. The future is largely a social construct [85], and how HCI designers and researchers conceptualize the future shapes their design proposals of the future. In other words, how temporality is represented and used in design futuring affects and is affected by other cultural and political frames of what the future is. In this mode we argue that it is crucial that researchers in design futuring explore and reflect on the notion of temporality itself to unfold the critical, political, and transformative dimensions of futures.

One common visual representation of the future is the *'futures cone'* or *'Voros cone'* (Figure 1) after Joseph Voros, who popularized it in futures studies in 2000s, although the idea of the cone was used as early as 1990 [98]. Within the design community, the idea of the cone was introduced by Candy, popularized by Dunne and Raby [30], and adopted and reinterpreted by other design futures researchers [23].

The cone visualizes relationships between various types of futures such as probable, plausible, possible, preferable and others. However, while it introduces some nuance into describing futures, expanding beyond the linear path and challenging the idea of predictability, it is also a simplified representation with a Western, English-speaking bias. In the cone, the future progresses, so to speak, in an apparently multi-directional fashion radiating from a single point called 'the present' on the left, towards multiple futures on the right. The single-point origin of time also implies a shared present, which can obscure complexities of historical context as well as the diversity and situatedness of presents. This representation of the future, and its widespread use in design futuring, illustrates how cultural and linguistic conventions can embed themselves even in those discourses that attempt to be critical, pluralistic and self-reflexive. Thus, design futuring researchers need to challenge how dominant representations of temporality figure into our understanding and design of futures [78].

Designers use various common metaphors when conceptualizing futures and temporality such as future as progress, time as a line, time as a resource and others [53]. Recent research in cognitive science has illuminated how various aspects of linguistic, cultural and personal experience, including metaphors, influence temporal reasoning [17]. A vivid example of an unconventional

metaphor of time is the Aymara language, which is an Amerindian language spoken in the Andean highlands of

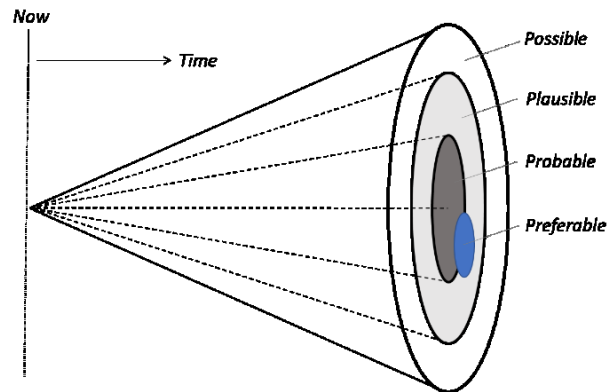


Figure 1. Futures Cone, Adapted from Joseph Voros (Graphic Design Credit: Sandjar Kozubaev)

western Bolivia, southeastern Peru, and northern Chile [70]. It uses a static mapping in which the future is behind us and the past is in the front.

This mapping is used not just linguistically, with the basic word for FRONT (nayra 'eye/front/sight') as the basic word for PAST, and the basic word for BACK (qhipa, 'back/behind') as the basic term for FUTURE, but also gesturally. When Aymara speakers refer to the future they gesture backwards and when referring to the past, they gesture forwards. This example shows how *"fundamental concepts such as temporal reasoning, can get shaped in specific ways to generate cultural variability."* [70]. Conceptual frameworks of the future are hence culturally situated. Attending to these dimensions of temporal reasoning in design futuring projects can help contest and reimagine them in productive, creative ways.

To appreciate how these linguistic schemas can shape broader social and political discourse, we turn to STS and the notion of anticipation. Anticipation is the affect and subjectivity associated with the future and its indeterminacy. Anticipation is not a reaction but 'a way of actively orienting oneself temporally' [1]. In other words, anticipation is how the notion of the future instantiates as a felt experience through various *'anticipatory regimes'*, which demand a certain kind of response, such as global health programs on biodiversity and biodefense. These programs organize prevention tactics and mechanisms as well as various rapid-response infrastructures. HCI and design research projects exist within current global or national anticipatory regimes and when doing design futuring work, we must reflect on how our future vision challenges or reinforces such anticipatory regimes.

For HCI design to be reflective about temporality, we suggest framing temporality as malleable and contestable, thereby opening new possibilities and ways of speculating about the future. First, HCI designers can explore alternative and novel notions of temporality and make them more visible and interactive. For example, Odom *et al.*'s work on slow design

illustrates [72-74] how HCI design can support reflections and subjective experiences of time such as anticipation, memory and re-visiting the past. Soro *et al.* propose an alternative take on the futures cone by flipping its orientation, much like the Aymara, to designing for the past [90].

Second, HCI design can support inventive exploration of metaphors for temporality. Metaphors have long been used as a tool in HCI design [11]. More recently, researchers have proposed that generating new metaphors can help not only design better interfaces, but also reframe societal issues around technology [59-61]. Since both mental and embodied metaphors (e.g., gesturing) are central to temporal reasoning, as described above, expanding alternative notions of temporality with new metaphors through HCI design can enrich design futuring both for researchers and the communities they serve.

Finally, HCI designers can explore how the temporality of futures is political. Mazé's practice-based research in SWITCH! Energy Futures explores temporal politics of making a difference by speculating on various ways of materializing future energy production and consumption [65]. Arguing that "the future is not empty, it is open", Mazé encourages designers to reflect on the temporal politics of imagining and designing "particular (out of all possible) futures" [65]. By presenting these examples of alternative temporalities, metaphors and temporal politics, we argue it is crucial that design futuring researchers explore and reflect on the notion of temporality itself. To unfold the political, critical and transformative dimensions of futures, researchers can account for questions such as:

- What notion (metaphor or representation) of temporality is used in the project and why? How and to whom is it visible or invisible in the project?
- Does the research project benefit from existing anticipatory regimes (e.g., discourses on risk, uncertainty, fear, etc.) and how should researchers account for that?
- Does the research project enable the use and expression of alternative notions of temporality by the relevant stakeholders (participants, audience members, communities of practice, etc.)?

Reflective Mode 3: Positionality: Futuring from Somewhere

This reflective mode discusses how design futuring researcher can reflect on and be transparent about the power they hold through their work. Placing technologies in the future does not relieve one from understanding the broader systems in which technologies are made and used, and the politics of those systems. By not only presenting the artifact, but also framing its use and the way it is presented, designers who engage in design futuring hold power and responsibility [63]. No knowledge creation comes from 'nowhere', but knowledge instead is a view from 'somewhere' [41], and designer-researchers can benefit from reflecting upon what their particular somewhere is [87]. Calls for reflection in

design have been made before in HCI [4, 28, 83] and in speculative design [77, 96], but we consider it important to continue expanding this call to design futuring, because by acknowledging this situated and specific context, designers can open up consideration of perspectives from elsewhere. We draw on the definition by Sengers *et al.* [87] of reflection "as referring to critical reflection, or bringing unconscious aspects of experience to conscious awareness, thereby making them available for conscious choice." We further draw on prior HCI researchers' related calls for reflexivity—for scholars to "critically reflect on the practices that their work seeks to amplify, and the ways in which those practices are situated within a larger cultural and political milieu" [28]. When situated in the future and thereby outside of the present, design futuring can appear apolitical and without current consequences. But as we show, design futuring is always situated 'somewhere' and by making these criteria more explicit, designers and researchers can expand what counts as design futuring work and define and develop criteria by which to judge design futuring work, thereby strengthening the field as a whole.

This reflective mode draws attention to the multiplicity of experiences and perspectives in the present; the present is not a singular point on the futures cone universally experienced by everyone, but rather a set of multiple experiences. From each of these experiences and perspectives, what seems like possible, plausible, probable, or preferable futures may differ. This suggests paying attention to the experiences related to design practice - including both the experiences involved in the practice of designing, and in the experiences of use. Design futures, as a technical practice, create political centers and margins of whose futures get to matter more or less (see also [45]). Reflection on one's position as designer-researcher allows for the identification of not only the center of a technical practice, but what is marginalized [87]. Reflection may also draw attention to the ways in which futures work is already being done by others (but not recognized as such), including by communities who we might consider research participants, co-designers, or collaborators.

O'Leary *et al.*'s project in engaging an African American community group with futuring methods reflects the need to both demystify the elite status of design and acknowledge the ways in which design practice may perpetuate forms of institutional racism and privilege [71]. Baumann *et al.* explicitly discuss how speculative design and design fiction were used in a local participatory project, reflecting on the need to understand and communicate a community's preferable future that is "tied to local African-American cultural norms and social practices" in contrast with dominant futures espoused by Silicon Valley [5]. Recognizing these existing practices provides opportunities to engage in and understand alternate forms of futuring work.

Explicit reflection in design futuring might be of particular importance as the field deploys many strategies that enable

the designer to distance oneself from the work. Power and privilege is often placed in the artifact which contains the designers' voice [76]. In addition, it also opens up the work on a political level by recognizing how research methods are 'world-shaping phenomena' [80] even if presented as existing in the future. While artifacts might appear to speak for themselves, their voice is not always clear and transparent. Ambiguity can be a useful tool to stimulate debate and provoke responses in this field of design, but this should not relieve the design researchers from positioning themselves unambiguously in regard to their work. Such ambiguity is closely aligned with the notion of 'cognitive estrangement', characteristic of the science fiction literary genre [93]. Some deploy humor and irony (see for example [44] and [14], who emphasize the positive aspects of these strategies). These means might make complex topics more palpable, but by allowing the maker or viewer to shrug them off as a joke and "clearly not real", they might also limit the accountability of the designer-researcher. In addition, humor and irony are also highly culturally situated, which might thereby act as gatekeepers of what is understood as design futuring and who gets to future.

In addition to a political aspect of design futuring work, reflection can have practical outcomes. Reflecting on our own experiences conducting and publishing futures research, we have found that this kind of work is often reviewed and valued on the basis of the aesthetic quality and craft of the design work, the novelty/interest of the context, and the imaginativeness of the proposals/design work. In contrast, questions and comments on the researchers' position arise less often. While these criteria are undisputedly relevant to design research, open and transparent reflection on one's stance and position as a designer can be useful as a means to make the criteria the design work explicit. This in turn makes the criteria not only open for designers themselves to acknowledge and understand their position, but also provides potential reviewers with criteria by which they can evaluate, compare and judge the work. If design researchers, for example, state that they aim to provide a specific stance, the reviewers can evaluate to which extent the work represents and embodies this stance and whether that is a useful means to address the problem stated.

An example of this type of reflection can be found in Søndergaard and Hansen [64], who draw heavily on feminist theory and the notion of 'staying with the trouble' to position themselves and the focus of their design work. The authors explicitly and transparently discuss this position as their 'somewhere' from which they start their exploration of a specific technology. In Schulte *et al.* [84] an artifact is presented with more applied reflections, derived from the practical work of developing the design fiction. Thereby the authors refrain from positioning themselves towards the work that has been developed and the burden of interpreting the artifact and positioning it lies entirely with the audience of the artifact. Using the questions we present in this reflective mode might enable the authors to acknowledge the values

that influenced their fiction, which values were assumed in the audience and which aspects of their work contains the novelty of the artifact.

Reflection should be part of the whole process and will be different for each project. As this is not an activity that can be addressed in one particular section or in hindsight when writing up, we refrain from giving a simple checklist of recommendations of how to structure reflection in design futuring. Based on our reflections, we suggest the following questions as a starting point:

- How were decisions made, who was included and what questions were (deliberately) left out? Whose futures get represented as legitimate in design, and whose do not?
- Who are the designer-researchers in a particular project, and what expertise and politics do they have? What politics (in the broadest sense) were reflected on in the process?
- Why was a particular future created, what (implicit or explicit) politics are suggested through the authors' and designers' perspectives?
- What types of privilege might the designer-researcher have, and what structures of power might the design artifacts be supporting or contesting?

Reflective Mode 4: Engaging with the Real World

This reflective mode encourages researchers engaging in speculative or futures-oriented work to consider how their work engages with and ultimately impacts the real world, from conception to outcome. We are not suggesting that design futuring always requires some sort of participation to be valuable. Design futuring *can* be valuable without direct and active participation. The goal of this reflective mode is to broaden the scope of what engagement with the real world could be. Unlike experimental or evaluative work of design prototypes, in which impact can be considered by its effects on particular populations under study, design futuring does not tend to hold immediate, material impact over specific persons. Nevertheless, the results of design futuring may yield very specific artifacts, institutions or organizations that affect people quite directly [71]. Even the simple scenarios of ubiquitous computing in Weiser's speculative work, Computers for the 21st Century provided a vision and guidance to multi-billion dollar industries of smartphones and Internet of Things devices [6, 100]. As past work at CHI has indicated, the real-world impacts of this new age have been uneven [37]. In this section, we reflect on how, as researchers and practitioners, we might better account for and anticipate the ways in which speculation engages and impacts the real world.

First, we need consider how we, as researchers, can better involve people, individuals, and organizations in speculative research. Recent work in HCI and design has engaged these questions, informing co-speculators [26], media stakeholders and cultural commentators [39, 40], or producing platforms for communities to express preferable futures [16, 54, 71, 97]. In the broadest sense, there is an opportunity to consider

the extent to which design futuring can become a more participatory practice. The challenge here for researchers is to curate such engagements that present deep and compelling futures, which remain open to be shaped by others. This engagement with the real world could be envisaged as trajectories [9] across multiple stages of a research project; from initial conception of sites for speculation; to critiquing work as it is iterated; to experiencing or engaging with artifacts produced through design futuring. With the Datacatcher project, Gaver *et al.* [40] put a carefully designed counterfactual artifact [99] into the hands of ‘*cultural commentators*’ [39], from marketers, academics, film-makers and local publics. To push this further though, what would it mean to seek participation earlier on in such a project? Such that communities themselves might envision the data collected and displayed by such a device?

Second, we need to consider the longer-term impact that speculative artifacts carry after they are produced and distributed and how they might affect real-world practices, processes, and communities. Speculations often skirt the boundaries of fake and real; design futuring can rely on particular familiar aesthetics and a ‘*future mundane*’ [69] such that it’s not immediately clear that speculation is at play. Design futuring (especially as critique) can be all the more compelling for inviting an audience to question their reality [24]. Especially as the boundaries of reality are blurred in contemporary media, how can researchers appropriately account for the consequences of misinterpreted speculation? For example, Søndergaard *et al.* [89] speculate on a dystopian PeriodShare menstrual tracking app and service which entailed a live Kickstarter page and appearance at trade shows as vehicles for the research. Doing such research ethically, and responsibly, requires considerable care, reflection and control of the contexts in which such work is encountered. Speculative artifacts rarely exist in a vacuum. As they are shared and distributed, stakeholders with diverse incentives may take notice, employing them in ways that may or may not match the values of the speculations’ original authors.

We hence offer a number of points of reflection to consider how design future engages with the real world:

- What are the touchpoints or trajectories of a design futuring project where opportunities could be created for participatory engagement with the speculations at hand?
- What steps have been taken to consider and guide the impact of the design futuring project and artifact(s)?
- How can researchers responsibly produce and engage publics with easily misconstrued envisioning?
- More explicitly, and taking care to consider the positionality of the researchers (see Reflective Mode 3), who specifically gains from design futuring, and who may not? How can the designer-researcher account for this within their work?

Reflective Mode 5: How Design Futuring Generates New Knowledge

Within HCI research, speculative design and related approaches to futuring, have been incorporated as a *research method*; however, we often lack a clear understanding of *how* design futuring generates new knowledge and contributes to the field. We offer two ways to reflect on this. First, we suggest that speculative design research in HCI could build upon the longstanding empirical focus on exploring and understanding the diverse experiences of participants in relation to new technologies [22, 43, 66]. In the simplest terms, researchers could ask how speculative work can be presented to and experienced by participants, and by what means we can make sense of their engagement. Candy’s ‘*experiential scenarios*’, and Elsdén *et al.*’s ‘*speculative enactments*’ offer examples of an engaging futures practice, and along with others [46, 55, 68] demonstrate how familiar empirical methods can be brought to bear in design futuring.

Second, and more fundamentally, we would urge researchers to consider more carefully the ‘*anticipated phenomena*’ [48] that are the crux of their research. Beyond any single technology, what near-future behavior, interaction, experience, values or infrastructures does the research seek to explore? Identifying up front the kinds of ‘*anticipatory phenomena*’ that the research hopes to illuminate, offers a much clearer playing field in which to understand and reflect upon the extent to which any speculative interventions actually generate new knowledge. For example, Fox *et al.* present Vivewell [36], a design fiction about data practices relating to menstrual tracking. The work is striking for its aesthetic, and basis in existing data policies of menstrual tracking apps. However, through this reflective mode, we could push the authors to think more about how to engage research participants to develop empirical reflections upon the speculations presented. How could anticipated phenomena – such as “*how particular bodies may get surveilled or controlled by a menstrual tracker*” – be explored with these participants? We would further argue that committing to investigating particular anticipated phenomena with participants can act as a valuable constraint on speculative work, where the researcher must constantly negotiate between aspects of an envisioned world, and the participant’s real-world engagement with speculative materials [32, 33].

Finally, we note that the content of design futuring rarely explicitly relates in any direct way to prior speculative work; nor offers resources for subsequent speculation to build upon. In some cases, it’s often unclear how the possible worlds envisioned through a design futuring approach, could be woven in with any other worlds. Could design futuring research become more interoperable? How could we encourage practices of building upon each other’s work in more than just a shared methodology? How might researchers ‘share’ aspects of a speculation, and have a sense of building up knowledge about anticipated phenomena, or particular near-future technologies? For example, Elsdén *et*

al. present Abacus Datagraphy [33] as a company offering data-driven documentary of a wedding; Noortman *et al.* [68] describe HawkEye Technologies as a company who produce smart care homes. What would it require, and what would it mean, for other researchers to envisage further services or interactions with these products and services?

Relatedly, in our experience, it is rare for design futuring research to acknowledge limitations to the work. Such limitations allow for reflexivity, and acknowledgement of the many positions and assumptions adopted in doing exploratory, speculative work. Further, they could offer a clearer path for future work that improves upon or reorients prior work. In this vein, we suggest that as a field, we generally struggle to evaluate design futuring work, and the different kinds of contributions such work can make. A more empirical focus (among others) could offer one such basis.

To begin engaging in this mode of reflection, we suggest the following questions as a starting point:

- Are there clear and compelling anticipatory phenomena in this design futuring project?
- How well does the speculation relate back to aspects of the real world such that insight can be gained into the anticipated phenomena (e.g., through design, co-design, participant engagement, etc.)?
- How could the project connect with or inhabit aspects of other related design futuring work?
- How does a given project develop resources that could be leveraged for further envisioning?
- How clearly are the limitations of design futuring work articulated, and do these offer avenues for future work and iteration?

DISCUSSION

In the preceding sections, we proposed five reflective modes, elaborated on their rationale and background, and proposed initial questions to engage with each mode. In this section we outline some of the implications of these reflective modes, their limitations as well as future directions.

We begin the discussion by reflecting on and acknowledging the limitations of our work. The proposed five reflective modes emerged from discussions and analysis among seven HCI researchers from diverse disciplinary backgrounds, and from analyzing a significant amount of design futuring work, but the modes are by no means exhaustive. While our aim was to develop reflective modes that could be applied by other researchers, we also invite others to not only engage in these modes but also re-interpret and critique them based on their own positionality and add other modes we failed to see or articulate. As described in our methods section, our own perspective comes from a certain degree of economic, educational, racial, bodily, and other privileges, and more perspectives on design futuring are needed.

Having acknowledged some of the limitations of our approach, we turn to the question of how to practice reflective modes and, more generally, be attentive to

reflexivity in design futuring. Our initial motivation to develop these reflective modes was a sense of necessity. We as authors all practice design futuring approaches that aspire to contribute to knowledge and provoke debate, but we want to deepen our understanding of how our work delivers on these claims and how it relates to others' work. Developing reflective practices can help researchers make more informed design decisions, foreground potential shortcomings and biases, and generate new design opportunities. We note that the proposed reflective modes are a non-exhaustive yet fruitful suite of resources to help design futuring researchers be more reflexive in their work. They can be used flexibly at different stages and in different combinations.

At the same time, we see potential challenges and obstacles in engaging in such reflective practice. For example, diversity in who gets to future is easy to aspire to but requires effort to practice for a variety of systemic reasons. Furthermore, reflective practice has to be deliberate and it involves time and effort. Given the realities of academic knowledge production it is easy to omit it both consciously and unconsciously. By articulating each reflective mode, we demonstrate ways for design futuring researchers to reflect on the impact and contribution of their work; before, during, and after carrying out a design futuring research project. Reflexivity in design futuring cannot be limited to an isolated workshop or an encounter in a gallery. Rather, it should be embedded throughout the entire lifecycle of a research project: from conception to publication and beyond. While researchers already practice forms of reflection in their work, making this reflective practice explicit and continuous, and reporting on it, can help readers, reviewers, and future researchers better understand the process of design futuring.

We envisage that the proposed reflective modes can serve as productive resources for design futuring researchers in at least three ways.

Analysis: We envisage these modes will support researchers and practitioners in better analyzing their design futuring work. This may be to reflect on past, ongoing or planned practice. For example, positionality (Reflective Mode 3) can be used in evaluating whether certain biases or privileges are being overlooked and how that might impact the claims and contributions of the work. Clearly, these reflective modes could also be used to evaluate and review design futuring work for publication, curation and funding. Furthermore, developing a deeper reflective practice in design futuring could encourage researchers to engage with other disciplines that have a long tradition of theorizing socio-political and socio-technical dimensions of the future and temporality such as futures studies, STS, design studies and others.

Articulation: Each of the modes offer researchers and practitioners new ways to think about and articulate their work. This may be to better acknowledge contributions or limitations, particular design choices, or the impact of one's work beyond a single publication. Relatedly, we envisage these modes may also support pedagogy to ensure that

students are more cognizant of how they begin to use and deploy design futuring methods. For example, reflecting on formgiving (Reflective Mode 1) can help articulate work by encouraging researchers to elaborate on choices of material and form, and their influence on the envisioned future

Generation: We finally suggest that the reflective modes can be generative of new ideas, questions and nuance to ongoing projects. One might consider how to make a project better engage with the real world, address specific anticipatory phenomena, or encompass alternative temporal logics. Where a reflective mode highlights some shortcomings, or opportunities, they may also stimulate ideas for entirely new projects and collaborations. For example, attending to temporality (Reflective Mode 2) can help generate new work by encouraging researchers to explore alternative temporal framings through their work.

CONCLUSION

In conclusion, we contribute five reflective modes for design futuring. These modes can serve as productive resources to help design futuring researchers articulate their work, generate new directions for their work, as well as analyze their own and others' work. The modes are:

(1) Attending to how designerly formgiving results in a specific artifact and how situated experiences help articulate the way design crafts particular imagined futures. We describe how, by presenting one specific artifact to imagine one specific future, design 'closes down' thinking about some futures while 'opening up' thinking about a particular future in greater richness and detail. We invite design futuring researchers to reflect on how the particularities of a design's form, materials, etc., shape the imagined future it presents.

(2) We reflect on how, particularly for design futuring work, attending to temporal representations as culturally situated helps surface latent assumptions around how futures are conceptualized. We outline ways for design futuring researchers to consider what temporal representations are used in a project and why, how the project engages with existing anticipatory regimes regarding future-oriented societal expectations, and how the project might support alternative notions of temporality.

(3) Echoing recent calls for researcher reflexivity throughout HCI, we specifically highlight ways that design futuring researchers can more thoughtfully consider their own positionality and privilege. We call on design futuring researchers to reflect on their own expertise and politics; on agendas or structures of power that their work might support or contest; and on whose futures get represented as legitimate and whose do not.

(4) Attending to how design futuring engages the real world reveals gaps and opportunities. We surface an opportunity for design futuring researchers to continue reflecting on ways to responsibly engage publics in futuring while being cautious about the potential for designs to seem deceptive, unethically 'real' or otherwise inappropriate. In seeking tangible impact

beyond academia, it is essential to critically consider who participates in design futuring, who gains from design futuring and who does not.

Finally, (5) we provide avenues for reflecting on how design futuring produces knowledge: via investigating 'anticipatory phenomena'; connecting to or building upon others' design futuring works, and acknowledging one's limitations to open avenues for future work and iteration.

We do not intend for these reflective to be exhaustive set or to serve as a mandatory checklist. Rather, we contribute these reflective modes in a spirit of open-ended generativity to help future-oriented HCI approaches continue to grow, strengthen, and deepen their practices and accountabilities. Future research can address how these and other reflective modes relate to each other and develop empirical contributions of how they influence design futuring work. As HCI takes on pressing societal challenges, design futuring has an important role to play in troubling dominant techno-logics and imagining critical alternatives; a role that must necessarily be reflective.

ACKNOWLEDGEMENTS

Beyond the first author, who led and organized this research, the order in which the authors are listed does not necessarily reflect the highly collaborative and iterative nature of this research and the resulting relative contributions. The authors express their gratitude to other colleagues, advisors and reviewers for their feedback in the development of this paper.

REFERENCES

- [1] Vincanne Adams, Michelle Murphy and Adele E Clarke. 2009. Anticipation: Technoscience, Life, Affect, Temporality. *Subjectivity* 28, 1, 246-265. <http://dx.doi.org/https://doi.org/10.1057/sub.2009.18>
- [2] James Auger. 2013. Speculative Design: Crafting the Speculation. *Digital Creativity* 24, 1, 11-35. <http://dx.doi.org/https://doi.org/10.1080/14626268.2013.767276>
- [3] Jeffrey Bardzell and Shaowen Bradzell. 2013. What Is Critical About Critical Design. In *Proceedings of ACM SIGCHI Conference on Human Factors in Computing Systems*. ACM, New York, 3297-3306. <http://dx.doi.org/10.1145/2470654.2466451>
- [4] Shaowen Bardzell. 2010. Feminist Hci: Taking Stock and Outlining an Agenda for Design. In *Proceedings of Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, Atlanta, Georgia, USA, 1301-1310. <http://dx.doi.org/10.1145/1753326.1753521>
- [5] Karl Baumann, Benjamin Stokes, François Bar and Ben Caldwell. 2017. Infrastructures of the Imagination: Community Design for Speculative Urban Technologies. In *Proceedings of Proceedings of the 8th International Conference on Communities and Technologies*. ACM, Troyes, France, 266-269. <http://dx.doi.org/10.1145/3083671.3083700>

- [6] Genevieve Bell and Paul Dourish. 2007. Yesterday's Tomorrows: Notes on Ubiquitous Computing's Dominant Vision. *Personal Ubiquitous Comput.* 11, 2, 133-143. <http://dx.doi.org/10.1007/s00779-006-0071-x>
- [7] Wendell Bell. 2003. *Foundations of Futures Studies Human Science for a New Era. Volume 1. History, Purposes and Knowledge.* . Transaction Publishers, New Brunswick, NJ.
- [8] Steve Benford, Andy Crabtree, Martin Flintham, Adam Drozd, Rob Anastasi, Mark Paxton, Nick Tandavanitj, Matt Adams and Ju Row-Farr. 2006. Can You See Me Now? *ACM Trans. Comput.-Hum. Interact.* 13, 1, 100-133. <http://dx.doi.org/10.1145/1143518.1143522>
- [9] Steve Benford, Gabriella Giannachi, Boriana Koleva and Tom Rodden. 2009. From Interaction to Trajectories: Designing Coherent Journeys through User Experiences. In *Proceedings of Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.* ACM, Boston, MA, USA, 709-718. <http://dx.doi.org/10.1145/1518701.1518812>
- [10] Steve Benford, Chris Greenhalgh, Andy Crabtree, Martin Flintham, Brendan Walker, Joe Marshall, Boriana Koleva, Stefan Rennick Egglestone, Gabriella Giannachi, Matt Adams, Nick Tandavanitj and Ju Row Farr. 2013. Performance-Led Research in the Wild. *ACM Trans. Comput.-Hum. Interact.* 20, 3, 1-22. <http://dx.doi.org/10.1145/2491500.2491502>
- [11] Alan F. Blackwell. 2006. The Reification of Metaphor as a Design Tool. *ACM Trans. Comput.-Hum. Interact.* 13, 4, 490-530. <http://dx.doi.org/10.1145/1188816.1188820>
- [12] Julian Bleecker. 2009. Design Fiction: A Short Essay on Design, Science, Fact and Fiction Retrieved from <http://www.nearfuturelaboratory.com>.
- [13] Mark A. Blythe and Peter C. Wright. 2006. Pastiche Scenarios: Fiction as a Resource for User Centred Design. *Interacting with Computers* 18, 5, 1139-1164. <http://dx.doi.org/10.1016/j.intcom.2006.02.001>
- [14] Mark Blythe and Enrique Encinas. 2016. The Coordinates of Design Fiction: Extrapolation, Irony, Ambiguity and Magic. In *Proceedings of Proceedings of the 19th International Conference on Supporting Group Work.* ACM, Sanibel Island, Florida, USA, 345-354. <http://dx.doi.org/10.1145/2957276.2957299>
- [15] Mark Blythe, Enrique Encinas, Jofish Kaye, Miriam Lueck Avery, Rob McCabe and Kristina Andersen. 2018. Imaginary Design Workbooks: Constructive Criticism and Practical Provocation. In *Proceedings of Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems.* ACM, Montreal QC, Canada, 1-12. <http://dx.doi.org/10.1145/3173574.3173807>
- [16] Augusto Boal. 2008. *Theater of the Oppressed.* Pluto Press,
- [17] Lera Boroditsky. 2011. How Languages Construct Time. In *Space, Time and Number in the Brain,* Stanislas Dehaene and Elizabeth Brannon Eds. Oxford University Press, 333--341.
- [18] Barry Brown, Alexandra Weilenmann, Donald McMillan and Airi Lampinen. 2016. Five Provocations for Ethical HCI Research. In *Proceedings of Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems.* ACM, San Jose, California, USA, 852-863. <http://dx.doi.org/10.1145/2858036.2858313>
- [19] Stuart Candy. 2010. The Futures of Everyday Life: Politics and Design of Experiential Scenarios. . thesis. University of Hawai'i Manoa,
- [20] Stuart Candy and Jake Dunagan. 2017. Designing an Experiential Scenario: The People Who Vanished. *Futures* 86, 136-153. <http://dx.doi.org/https://doi.org/10.1016/j.futures.2016.05.006>
- [21] John M. Carroll. 2000. *Making Use: Scenario-Based Design of Human-Computer Interactions.* MIT Press, Cambridge, MA.
- [22] Rachel Clarke and Pete Wright. 2012. Evocative of Experience: Crafting Cross-Cultural Digital Narratives through Stories and Portraits. In *Proceedings of Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design.* ACM, Copenhagen, Denmark, 318-321. <http://dx.doi.org/10.1145/2399016.2399066>
- [23] Coulton P., Burnett, D., Gradinar, A. 2016. Games as Speculative Design: Allowing Players to Consider Alternate Presents and Plausible Futures. In *Proceedings of Brighton UK.*
- [24] Coulton P., Lindley, J., Ali, H. 2016. Design Fiction: Does the Search for Plausibility Lead to Deception? . In *Proceedings of Proceedings of DRS 2016, Design Research Society 50th Anniversary Conference.* Brighton, UK.
- [25] Paul Coulton, Joseph Lindley, Miriam Sturdee and Mike Stead. 2017. Design Fiction as World Building. In *Proceedings of Research Through Design Conference.* Edinburgh, UK, 163-179. <http://dx.doi.org/10.6084/m9.figshare.4746964>
- [26] Audrey Desjardins, Jeremy E. Viny, Cayla Key and Nouela Johnston. 2019. Alternative Avenues for IoT: Designing with Non-Stereotypical Homes. In *Proceedings of Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems.* ACM, Glasgow, Scotland Uk, 1-13. <http://dx.doi.org/10.1145/3290605.3300581>

- [27] Carl DiSalvo. 2012. *Adversarial Design*. The MIT Press, Cambridge, Massachusetts.
- [28] Lynn Dombrowski, Ellie Harmon and Sarah Fox. 2016. Social Justice-Oriented Interaction Design: Outlining Key Design Strategies and Commitments. In *Proceedings of Proceedings of the 2016 ACM Conference on Designing Interactive Systems*. ACM, Brisbane, QLD, Australia, 656-671. <http://dx.doi.org/10.1145/2901790.2901861>
- [29] Anthony Dunne. 2005. Hertzian Tales: Electronic Products, Aesthetic Experience, and Critical Design.
- [30] Anthony Dunne and Fiona Raby. 2013. *Speculative Everything: Design, Fiction, and Social Dreaming*. MIT Press, Cambridge, Massachusetts.
- [31] Chris Elsdén, David Chatting, Abigail C Durrant, Andrew Garbett, Bettina Nissen, John Vines and David S Kirk. 2017. On Speculative Enactments. In *Proceedings of Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, 5386-5399. <http://dx.doi.org/10.1145/3025453.3025503>
- [32] Chris Elsdén, Abigail C. Durrant, David Chatting and David S. Kirk. 2017. *Designing Documentary Informatics*. Association for Computing Machinery, Edinburgh, United Kingdom.
- [33] Chris Elsdén, Abigail Durrant, David Chatting, David Green and David Kirk. 2019. Abacus Datagraphy: A Speculative Enactment. In *Proceedings of RTD Conference*. <http://dx.doi.org/10.6084/m9.figshare.4746961.v1>
- [34] Chris Elsdén, Bettina Nissen, Andrew Garbett, David Chatting, David Kirk and John Vines. 2016. *Metadating: Exploring the Romance and Future of Personal Data*. Association for Computing Machinery, San Jose, California, USA.
- [35] Tom Feltwell, Shaun Lawson, Enrique Encinas, Conor Linehan, Ben Kirman, Deborah Maxwell, Tom Jenkins and Stacey Kuznetsov. 2018. "Grand Visions" for Post-Capitalist Human-Computer Interaction. In *Proceedings of Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, Montreal QC, Canada, 1-8. <http://dx.doi.org/10.1145/3170427.3170609>
- [36] Sarah Fox, Noura Howell, Richmond Wong and Franchesca Spektor. 2019. Vivewell: Speculating near-Future Menstrual Tracking through Current Data Practices. In *Proceedings of Proceedings of the 2019 on Designing Interactive Systems Conference*. ACM, San Diego, CA, USA, 541-552. <http://dx.doi.org/10.1145/3322276.3323695>
- [37] Diana Freed, Jackeline Palmer, Diana Minchala, Karen Levy, Thomas Ristenpart and Nicola Dell. 2018. "A Stalker's Paradise": How Intimate Partner Abusers Exploit Technology. In *Proceedings of Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, Montreal QC, Canada, 1-13. <http://dx.doi.org/10.1145/3173574.3174241>
- [38] Tony Fry. 2019. *Design Futuring : Sustainability, Ethics and New Practice*.
- [39] William Gaver. 2007. Cultural Commentators: Non-Native Interpretations as Resources for Polyphonic Assessment. *International Journal of Human-Computer Studies* 65, 4, 292-305. <http://dx.doi.org/https://doi.org/10.1016/j.ijhcs.2006.11.014>
- [40] William Gaver, Andy Boucher, Nadine Jarvis, David Cameron, Mark Hauenstein, Sarah Pennington, John Bowers, James Pike, Robin Beitra and Liliana Ovalle. 2016. The Datacatcher: Batch Deployment and Documentation of 130 Location-Aware, Mobile Devices That Put Sociopolitically-Relevant Big Data in People's Hands: Polyphonic Interpretation at Scale. In *Proceedings of Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. ACM, 1597-1607. <http://dx.doi.org/10.1145/2858036.2858472>
- [41] Donna Haraway. 1988. Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective. *Feminist Studies* 14, 3, 575-599. <http://dx.doi.org/10.2307/3178066>
- [42] Donna Jeanne Haraway. 2016. *Staying with the Trouble : Making Kin in the Chthulucene*. Duke University Press, Durham.
- [43] Marc Hassenzahl. 2010. *Experience Design: Technology for All the Right Reasons*. Morgan and Claypool Publishers,
- [44] Karey Helms and Ylva Fernaeus. 2018. Humor in Design Fiction to Suspend Disbelief and Belief. In *Proceedings of Proceedings of the 10th Nordic Conference on Human-Computer Interaction*. ACM, Oslo, Norway, 801-818. <http://dx.doi.org/10.1145/3240167.3240271>
- [45] bell hooks. 2015. *Feminist Theory : From Margin to Center*.
- [46] Noura Howell, John Chuang, Abigail De Kosnik, Greg Niemeyer and Kimiko Ryokai. 2018. Emotional Biosensing: Exploring Critical Alternatives. *Proc. ACM Hum.-Comput. Interact.* 2, CSCW, 1-25. <http://dx.doi.org/10.1145/3274338>
- [47] Sheila Jasanoff. 2015. Future Imperfect: Science, Technology, and the Imaginations of Modernity. In *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, University of Chicago Press, Chicago, 1-29.
- [48] Lindley Joseph, Dhruv Sharma and Robert Potts. 2014. Anticipatory Ethnography: Design Fiction as an Input

- to Design Ethnography. *Ethnographic Praxis in Industry Conference Proceedings* 2014, 1, 237-253. <http://dx.doi.org/10.1111/1559-8918.01030>
- [49] Os Keyes, Josephine Hoy and Margaret Drouhard. 2019. Human-Computer Insurrection: Notes on an Anarchist HCI. In *Proceedings of Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, Glasgow, Scotland Uk, 1-13. <http://dx.doi.org/10.1145/3290605.3300569>
- [50] David Kirby. 2010. The Future Is Now: Diegetic Prototypes and the Role of Popular Films in Generating Real-World Technological Development. *Social Studies of Science* 40, 1, 41-70. <http://dx.doi.org/https://doi.org/10.1177/0306312709338325>
- [51] Sandjar Kozubaev. 2016. Stop Nigmas: Experimental Speculative Design through Pragmatic Aesthetics and Public Art. In *Proceedings of NordiCHI '16*. ACM, Gothenburg, Sweden, 1-10. <http://dx.doi.org/10.1145/2971485.2993921>
- [52] Sandjar Kozubaev. 2018. Futures as Design: Explorations, Images, and Participations. *Interactions* 25, 2, 46-51. <http://dx.doi.org/10.1145/3178554>
- [53] George Lakoff and Mark Johnson. 1981. *Metaphors We Live By*. University of Chicago Press, Chicago.
- [54] Daniel Lambton-Howard, Robert Anderson, Kyle Montague, Andrew Garbett, Shaun Hazeldine, Carlos Alvarez, John A. Sweeney, Patrick Olivier, Ahmed Kharrufa and Tom Nappey. 2019. Whatfutures: Designing Large-Scale Engagements on Whatsapp. In *Proceedings of Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, Glasgow, Scotland Uk, 1-14. <http://dx.doi.org/10.1145/3290605.3300389>
- [55] Shaun Lawson, Ben Kirman, Conor Linehan, Tom Feltwell and Lisa Hopkins. 2015. Problematising Upstream Technology through Speculative Design: The Case of Quantified Cats and Dogs. In *Proceedings of Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. ACM, Seoul, Republic of Korea, 2663-2672. <http://dx.doi.org/10.1145/2702123.2702260>
- [56] Ann Light, Alison Powell and Irina Shklovski. 2017. Design for Existential Crisis in the Anthropocene Age. In *Proceedings of Proceedings of the 8th International Conference on Communities and Technologies*. ACM, Troyes, France, 270-279. <http://dx.doi.org/10.1145/3083671.3083688>
- [57] Joseph Lindley and Paul Coulton. 2015. Back to the Future: 10 Years of Design Fiction. In *Proceedings of Proceedings of the 2015 British HCI Conference*. ACM, Lincoln, Lincolnshire, United Kingdom, 210-211. <http://dx.doi.org/10.1145/2783446.2783592>
- [58] Joseph Lindley, Paul Coulton and Miriam Sturdee. 2017. Implications for Adoption. In *Proceedings of Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, Denver, Colorado, USA, 265-277. <http://dx.doi.org/10.1145/3025453.3025742>
- [59] Dan Lockton and Stuart Candy. 2018. A Vocabulary for Visions in Designing for Transitions. In *Proceedings of DRS 2018*. Limerick. <http://dx.doi.org/10.21606/dma.2018.558>
- [60] Dan Lockton, Devika Singh, Saloni Sabnis, Michelle Chou, Sarah Foley and Alejandro Pantoja. 2019. New Metaphors: A Workshop Method for Generating Ideas and Reframing Problems in Design and Beyond. In *Proceedings of Proceedings of the 2019 on Creativity and Cognition*. ACM, San Diego, CA, USA, 319-332. <http://dx.doi.org/10.1145/3325480.3326570>
- [61] Nick Logler, Daisy Yoo and Batya Friedman. 2018. Metaphor Cards: A How-to-Guide for Making and Using a Generative Metaphorical Design Toolkit. In *Proceedings of Proceedings of the 2018 Designing Interactive Systems Conference*. ACM, Hong Kong, China, 1373-1386. <http://dx.doi.org/10.1145/3196709.3196811>
- [62] Trieuvy Luu, Martijn van den Broeck and Marie Louise Juul Søndergaard. 2018. Data Economy: Interweaving Storytelling and World Building in Design Fiction. In *Proceedings of Proceedings of the 10th Nordic Conference on Human-Computer Interaction*. ACM, Oslo, Norway, 771-786. <http://dx.doi.org/10.1145/3240167.3240270>
- [63] Sus Lyckvi, Yiyang Wu, Maria Huusko and Virpi Roto. 2018. Eagons, Exoskeletons and Ecologies: On Expressing and Embodying Fictions as Workshop Tasks. In *Proceedings of Proceedings of the 10th Nordic Conference on Human-Computer Interaction*. ACM, Oslo, Norway, 754-770. <http://dx.doi.org/10.1145/3240167.3240269>
- [64] Marie Louise Juul Søndergaard and Lone Koefoed Hansen. 2018. Intimate Futures: Staying with the Trouble of Digital Personal Assistants through Design Fiction. In *Proceedings of Proceedings of the 2018 Designing Interactive Systems Conference*. ACM, Hong Kong, China, 869-880. <http://dx.doi.org/10.1145/3196709.3196766>
- [65] Ramia Maze. 2016. Design and the Future: Temporal Politics of 'Making a Difference.'. In *Design Anthropological Futures*, Rachel Charlotte Smith et al. Eds. Bloomsbury Academic.
- [66] John McCarthy and Peter Wright. 2004. *Technology as Experience*. MIT Press, Cambridge, MA.
- [67] Mike Michael. 2000. Futures of the Present: From Performativity to Prehension. In *Contested Futures: A*

- Sociology of Prospective Techno-Science*, Routledge, New York, 21-39.
- [68] Renee Noortman, Britta F. Schulte, Paul Marshall, Saskia Bakker and Anna L. Cox. 2019. Hawkeye - Deploying a Design Fiction Probe. In *Proceedings of Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, Glasgow, Scotland Uk, 1-14. <http://dx.doi.org/10.1145/3290605.3300652>
- [69] Nicholas Nova. 2019. Nicolas Nova: We Are Interested in Mundane Situations to Express Futures. Retrieved September 10, 2019 from <http://speculativeedu.eu/interview-nicolas-nova/>.
- [70] Rafael E. Núñez and Eve Sweetser. 2006. With the Future Behind Them: Convergent Evidence from Aymara Language and Gesture in the Crosslinguistic Comparison of Spatial Construals of Time. *Cognitive science* 2006, 30, 401-450. http://dx.doi.org/10.1207/s15516709cog0000_62
- [71] Jasper Tran O'Leary, Sara Zewde, Jennifer Mankoff and Daniela K. Rosner. 2019. Who Gets to Future?: Race, Representation, and Design Methods in Africatown. In *Proceedings of Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, Glasgow, Scotland Uk, 1-13. <http://dx.doi.org/10.1145/3290605.3300791>
- [72] William Odom. 2015. Understanding Long-Term Interactions with a Slow Technology: An Investigation of Experiences with Futureme. In *Proceedings of Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. ACM, Seoul, Republic of Korea, 575-584. <http://dx.doi.org/10.1145/2702123.2702221>
- [73] William Odom, Siân Lindley, Larissa Pschetz, Vasiliki Tsaknaki, Anna Vallgård, Mikael Wiberg and Daisy Yoo. 2018. Time, Temporality, and Slowness: Future Directions for Design Research. In *Proceedings of Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems*. ACM, Hong Kong, China, 383-386. <http://dx.doi.org/10.1145/3197391.3197392>
- [74] William Odom, Ron Wakkary, Jeroen Hol, Bram Naus, Pepijn Verburg, Tal Amram and Amy Yo Sue Chen. 2019. Investigating Slowness as a Frame to Design Longer-Term Experiences with Personal Data: A Field Study of Olly. In *Proceedings of Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, Glasgow, Scotland Uk, 1-16. <http://dx.doi.org/10.1145/3290605.3300264>
- [75] William Odom, John Zimmerman, Scott Davidoff, Jodi Forlizzi, Anind K Dey and Min Kyung Lee. 2012. A Fieldwork of the Future with User Enactments. In *Proceedings of Proceedings of the Designing Interactive Systems Conference*. ACM, 338-347. <http://dx.doi.org/10.1145/2317956.2318008>
- [76] James Pierce, Phoebe Sengers, Tad Hirsch, Tom Jenkins, William Gaver and Carl DiSalvo. 2015. Expanding and Refining Design and Criticality in HCI. In *Proceedings of Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. ACM, Seoul, Republic of Korea, 2083-2092. <http://dx.doi.org/10.1145/2702123.2702438>
- [77] Luiza Prado and Pedro Oliveira. 2014. Questioning the "Critical" in Speculative and Critical Design. Retrieved September 10, 2019 from <https://medium.com/a-parede/questioning-the-critical-in-speculative-critical-design-5a355cac2ca4#jb56pv4y7>.
- [78] L. Pschetz, Bastian, M., Speed, C. 2016. Temporal Design: Looking at Time as Social Coordination. In *Proceedings of Proceedings of DRS 2016, Design Research Society 50th Anniversary Conference*. Brighton, UK.
- [79] Stuart Reeves. 2012. Envisioning Ubiquitous Computing. In *Proceedings of Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, Austin, Texas, USA, 1573-1582. <http://dx.doi.org/10.1145/2207676.2208278>
- [80] Daniela K. Rosner, Saba Kawas, Wenqi Li, Nicole Tilly and Yi-Chen Sung. 2016. Out of Time, out of Place: Reflections on Design Workshops as a Research Method. In *Proceedings of Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. ACM, San Francisco, California, USA, 1131-1141. <http://dx.doi.org/10.1145/2818048.2820021>
- [81] Felix Salmon. 2018. The Creepy Rise of Real Companies Spawning Fictional Design. Retrieved September 2, 2019 from <https://www.wired.com/story/the-creepy-rise-of-real-companies-spawning-fictional-design/>.
- [82] Ziauddin Sardar. 2010. The Namesake: Futures; Futures Studies; Futurology; Futuristic; Foresight—What's in a Name? *Futures* 42, 3, 177-184. <http://dx.doi.org/https://doi.org/10.1016/j.futures.2009.11.001>
- [83] Ari Schlesinger, W. Keith Edwards and Rebecca E. Grinter. 2017. Intersectional HCI: Engaging Identity through Gender, Race, and Class. In *Proceedings of Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, Denver, Colorado, USA, 5412-5427. <http://dx.doi.org/10.1145/3025453.3025766>
- [84] Britta F. Schulte, Paul Marshall and Anna L. Cox. 2016. Homes for Life: A Design Fiction Probe. In *Proceedings of Proceedings of the 9th Nordic Conference on Human-Computer Interaction*. ACM,

- Gothenburg, Sweden, 1-10.
<http://dx.doi.org/10.1145/2971485.2993925>
- [85] Cynthia Selin. 2008. The Sociology of the Future: Tracing Stories of Technology and Time. *Sociology Compass* 2, 6, 1878-1895.
<http://dx.doi.org/10.1111/j.1751-9020.2008.00147.x>
- [86] Phoebe Sengers. 2011. What I Learned on Change Islands: Reflections on It and Pace of Life. *interactions* 18, 2, 40-48.
<http://dx.doi.org/10.1145/1925820.1925830>
- [87] Phoebe Sengers, Kirsten Boehner, Shay David and Joseph 'Jofish' Kaye. 2005. Reflective Design. In *Proceedings of Proceedings of the 4th decennial conference on Critical computing: between sense and sensibility*. ACM, Aarhus, Denmark, 49-58.
<http://dx.doi.org/10.1145/1094562.1094569>
- [88] Rachel Charlotte Smith, Kasper Tang Vangkilde, Mette Gislev Kjærsgaard, Ton Otto, Joachim Halse and Thomas Binder. 2016. *Design Anthropological Futures*. Bloomsbury Publishing,
- [89] Marie Louise Juul Søndergaard and Lone Koefoed Hansen. 2016. Periodshare: A Bloody Design Fiction. In *Proceedings of Proceedings of the 9th Nordic Conference on Human-Computer Interaction*. ACM, Gothenburg, Sweden, 1-6.
<http://dx.doi.org/10.1145/2971485.2996748>
- [90] Alessandro Soro, Jennyfer Lawrence Taylor and Margot Brereton. 2019. Designing the Past. In *Proceedings of Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, Glasgow, Scotland Uk, 1-10.
<http://dx.doi.org/10.1145/3290607.3310424>
- [91] Anne Spaa, Abigail Durrant, Chris Elsdon and John Vines. 2019. Understanding the Boundaries between Policymaking and HCI. In *Proceedings of Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, Glasgow, Scotland Uk, 1-15. <http://dx.doi.org/10.1145/3290605.3300314>
- [92] Erik Stolterman. 2008. The Nature of Design Practice and Implications for Interaction Design Research. *International Journal of Design* 2, 1.
- [93] Darko Suvin. 2014. Estrangement and Cognition. *Strange Horizons*, 24 November, 2014.
- [94] Joshua Tanenbaum. 2014. Design Fictional Interactions: Why HCI Should Care About Stories. *interactions* 21, 5, 22-23.
<http://dx.doi.org/10.1145/2648414>
- [95] Bruce M. Tharp and Stephanie M. Tharp. 2018. *Discursive Design : Critical, Speculative, and Alternative Things*.
- [96] Cameron Tonkinwise. 2014. How We Intend to Future: Review of Anthony Dunne and Fiona Raby, *Speculative Everything: Design, Fiction, and Social Dreaming*. *Design Philosophy Papers* 12, 2, 169-187.
<http://dx.doi.org/10.2752/144871314X14159818597676>
- [97] John Vines, Tess Denman-Cleaver, Paul Dunphy, Peter Wright and Patrick Olivier. 2014. Experience Design Theatre: Exploring the Role of Live Theatre in Scaffolding Design Dialogues. In *Proceedings of Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, Toronto, Ontario, Canada, 683-692.
<http://dx.doi.org/10.1145/2556288.2556960>
- [98] Joseph Voros. 2017. Big History and Anticipation. In *Handbook of Anticipation: Theoretical and Applied Aspects of the Use of Future in Decision Making*, Roberto Poli Ed. Springer International Publishing, Cham, 1-40. http://dx.doi.org/10.1007/978-3-319-31737-3_95-1
- [99] Ron Wakkary, William Odom, Sabrina Hauser, Garnet Hertz and Henry Lin. 2015. Material Speculation: Actual Artifacts for Critical Inquiry. In *Proceedings of Proceedings of The Fifth Decennial Aarhus Conference on Critical Alternatives*. Aarhus University Press, Aarhus, Denmark, 97-108.
<http://dx.doi.org/10.7146/aaahcc.v1i1.21299>
- [100] M. Weiser. 2002. The Computer for the 21st Century. *IEEE Pervasive Computing* 1, 1, 19-25.
<http://dx.doi.org/10.1109/mprv.2002.993141>
- [101] Richmond Y. Wong, Nick Merrill and John Chuang. 2018. When BCIs Have APIs: Design Fictions of Everyday Brain-Computer Interface Adoption. In *Proceedings of Proceedings of the 2018 Designing Interactive Systems Conference*. ACM, Hong Kong, China, 1359-1371.
<http://dx.doi.org/10.1145/3196709.3196746>
- [102] Richmond Y. Wong and Deirdre K. Mulligan. 2016. When a Product Is Still Fictional: Anticipating and Speculating Futures through Concept Videos. In *Proceedings of Proceedings of the 2016 ACM Conference on Designing Interactive Systems*. Association for Computing Machinery, Brisbane, QLD, Australia, 121-133.
<http://dx.doi.org/10.1145/2901790.2901801>