

Eliciting Values Reflections by Engaging Privacy Futures Using Design Workbooks

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Although “privacy by design” (PBD)—embedding privacy protections into products during design, rather than retroactively—uses the term “design” to recognize how technical design choices implement and settle policy, design approaches and methodologies are largely absent from PBD conversations. Critical, speculative, and value-centered design approaches can be used to elicit reflections on relevant social values early in product development, and are a natural fit for PBD and necessary to achieve PBD’s goal. Bringing these together, we present a case study using a design workbook of speculative design fictions as a values elicitation tool. Originally used as a reflective tool among a research group, we transformed the workbook into artifacts to share as values elicitation tools in interviews with graduate students training as future technology professionals. We discuss how these design artifacts surface contextual, socially-oriented understandings of privacy, and their potential utility in relationship to other values levers.

CCS Concepts: • **Security and privacy**~Social aspects of security and privacy • **Social and professional topics**~Computing / technology policy • *Applied computing*~Law, social and behavioral sciences • Human-centered computing~Empirical studies in HCI

KEYWORDS: Privacy by design; values in design; design workbooks; speculative design; design fiction; privacy

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1 INTRODUCTION

Regulators, industry, and advocacy groups increasingly call for privacy by design, looking for privacy to be “built-in” and positioned as the default in technology. One recurring question in privacy by design is how designers and engineers could and should engage prospective

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stakeholders throughout the design process, especially in early stages [32, 43, 60]—and do so in a way that recognizes what constitutes “privacy” changes based on context, situation, and subject position. Of note, Bamberger and Mulligan’s findings from interviews with chief privacy officers show that privacy professionals believe that addressing privacy requires “looking around corners” to anticipate how privacy concerns may arise in new technologies and practices [4:292]. Values in design research suggests that by understanding values held by stakeholders and values associated with or embedded in technologies, we can better acknowledge or anticipate possible values-related issues that may emerge from technologies’ use, including privacy [22,57,60]. Finding ways to elicit reflections and discussion on privacy-related values at the beginning of the design process can be useful in technology professionals’ work.

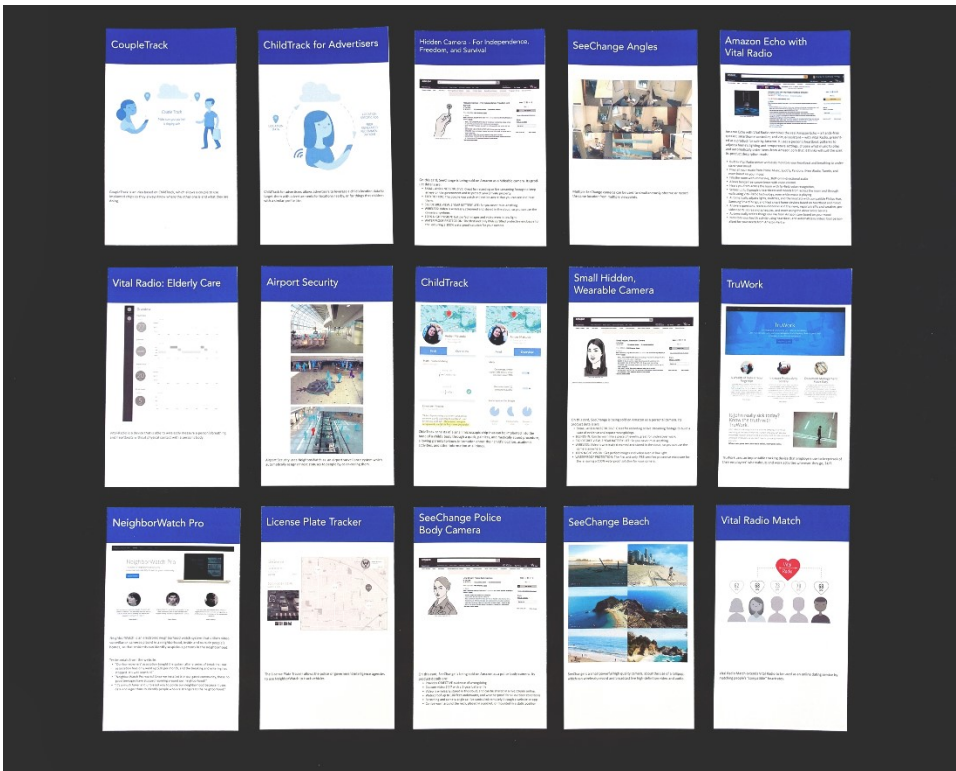


Fig. 1. Workbook designs presented as a set of cards.

We suggest that technology professionals can view and interact with *design workbooks*—collections of design proposals or conceptual designs, drawn together to allow designers to investigate, explore, reflect on, and expand a design space [25]—to elicit values reflections and discussions about privacy before a system is built, in essence “looking around corners” by broadening the imagination about what is possible. One particular domain of emerging technologies where privacy is increasingly invoked is biosensing technologies, or technologies that sense human bodies. These include wearable sensors, remote sensors, or camera-based technologies, where data is often shared and made available to other companies, groups, or individuals. While prior CSCW work has centered on biosensing data legibility and interpretability (e.g. [42,61]), what constitutes a violation of privacy with regard to these devices is not always clear. We find biosensing technologies a useful domain for our design workbooks to

explore how different configurations and relations between people, institutions, and technologies might implicate values related to privacy.

We transformed a pre-existing design workbook depicting imagined biosensing technologies, which was created by Wong, Van Wyk, and Pierce to reflect on privacy and surveillance issues related to emerging sensing technologies as design researchers [66]. We adapted and used these designs as interview prompts with an external audience—an expert population of graduate students preparing to enter technology-related professions—to understand how the workbooks could serve as tools to elicit values reflections. We find that participants are able to use the workbooks as “values levers” [56] to engage in explicit discussion around privacy-related values.

This paper makes two contributions. First it provides a case study showing how design workbooks of speculative design fictions can be used to engage stakeholders in eliciting values reflections—highlighting opportunities and potential obstacles in adapting workbooks originally used for researcher reflection into artifacts to share with external audiences. Second it more broadly suggests a role for designers and design methods in values-oriented discussions of privacy and in privacy by design.

2 BACKGROUND: CONNECTING VALUES, DESIGN, AND PRIVACY BY DESIGN

Our work takes place at the overlap of critical design-inspired approaches and value centered design work. We first discuss the potential to use critical design-inspired approaches for value centered design work, then propose how it can aid privacy by design.

2.1 Eliciting Values Reflections in Design

Work under the rubric of values in design seeks to identify values and create systems that better recognize and address values [39]. Value sensitive design (VSD) provides one framework to elicit and address values during the process of building systems. VSD includes looking at direct and indirect stakeholders of a technology or context; mapping benefits, harms, and values to the different stakeholders; and identifying potential values conflicts [22]. A variety of methods have been used in values in design and value sensitive design work to elicit stakeholders’ reflections on values, summarized by Shilton et al. [57], including interviews and design activities. Interviews are used to understand the values held by stakeholders such as developers and users. Design activities, including card activities, design scenarios, and probes, are able to provoke, elicit, and foster discussion of values (e.g. [10,21,23]).

The nature of social values as related to technological design has a history of scholarly debate over the sources and nature of values—such as asking if humans inscribe values into technologies, or if materials themselves embody values—and asking how values should inform design (e.g. [6,37,40,57,64]). In our work, we discuss social values as conceptions of what is good, proper, important, or desirable in human life [22,28]. The sources of values that we discuss are multiple [57], including ourselves as researchers and designers, our participants, the designs themselves, and broader social norms. Importantly, our goal is not to find and extract immutable values held by participants to create a set of design requirements. We seek to elicit values *reflections* from our participants; we want to understand how participants use values as a lens to understand and interpret the designs—particularly as they identify potential issues related to privacy and discuss ways to address those conflicts. In this sense, we are inspired by JafariNaimi et al.’s view of values as hypotheses, to use values to “examine what the situation is, what the possible courses of action are, and how they might transform the situation.” [37:97].

A largely separate line of design research under the broad rubric of speculative and critical design serves to surface values, critique social issues, and present alternative visions of the future by creating conceptual designs and design artifacts [17,51]. The artifacts created in these processes are considered “research products” rather than “prototypes”—that is, they are valued as

they exist now, rather than representing an incomplete design still in product development [48]. These designs exist largely outside processes of commercial mass production. This type of design research, rather than centered on user evaluation, is often evaluated as research through design. This includes documenting the design process, and articulating the design's relevance to real-world issues and the knowledge or understanding that is created through the design [67]. One such practice that we draw on is Gaver's design workbook method [25]. Design workbooks are collections of design proposals or conceptual designs, drawn together to investigate, explore, reflect on, and expand a design space; they may not be practical or immediately implementable; and they purposely lack implementation details, allowing designers to generate multiple stories of possible use [24,25]. We also draw on design fiction, a practice that uses imagined or speculative design concepts to explore and question possible futures; the design concepts act as "props" that help imply or create a broader fictional world in which they exist [7,41].

Values reflections are at the heart of these speculative and critical design practices: values are surfaced and contested by creating artifacts that articulate and present alternate worlds, centering different sets of values than what are experienced today. Yet these are largely authorial practices [51], focusing on the values that *designers and design researchers* surface, critique, and envision. Our work suggests that these design artifacts can be used to elicit values reflections among other populations who are not the designers. This follows the call by Elsdén et al. for speculative and critical design to broaden and engage with the "applied, participatory and experience-centered" aspects of the HCI field [19]. We are inspired by the applied design research method of speed dating [15,49], which is traditionally deployed early in a design process, engaging users with a large set of near-future prototypes, scenarios, or design ideas, in order to better understand future user needs. However, we present participants with a set of speculative design fictions, rather than a set of design ideas that we wish to develop into products. We are less interested in presenting designs to participants to evaluate our designs (nor are we looking to extract a set of values from them to be used as design requirements). Instead, we are looking to elicit *values reflections*, inspired by Sengers et al.'s call to design for critical reflection [55].

Our research builds on value centered design research that brings in speculative and critical design-inspired practices, often in the form of presenting stakeholders or participants with a speculative artifact or scenario. This includes Nathan et al.'s use of design noir to create values scenarios [45], Sengers' et al.'s documentation of speculative prototypes and installations to generate critical reflections [55], Hutchinson et al.'s technology probes [34], and Cheon et al.'s use of futuristic stories to elicit values from roboticists [13]. Our work adds to this in several ways. First, our designs were originally created in a research through design process that explicitly explored different aspects of privacy informed by a privacy analytical framework, providing the designs with analytical rigor focusing specifically on privacy, rather than values at large [66]. We re-deploy these artifacts, originally used for researchers' reflection, with new audiences to elicit values reflections and discussions. Second, our designs present speculative sociotechnical configurations, instead of highlighting new operational technologies in the way a technology probe or speculative prototype might. Our design variations emphasize different aspects of sociotechnical systems: sometimes emphasizing fictional values, social norms, legal regimes, or technologies. Collectively, our designs pay attention to multiple sources of values. Third we engage an expert population in values reflections, rather than users, in part to encourage discussion about how they might address values conflicts might through their technical practice.

2.2 Bridging Privacy By Design and Design

Recognizing the ways in which values can be embedded or promoted by design, regulators, academics, and members of industry have called for "privacy by design" (PBD)—considering

privacy throughout the design phase of products and services, and embedding privacy in technical and organizational measures [12,43,53]—to address growing privacy concerns with new and emerging technologies.

While privacy by design encourages a “holistic” approach, PBD tools and solutions often take the form of technical or engineering approaches, such as data minimization, anonymizing data, creating privacy dashboards, or using other privacy patterns (e.g. [29,30,52]). Other PBD tools and frameworks include: Privacy Impact Assessments, which articulate how data are gathered, used, shared, and maintained and potential privacy harms that might result [62]; the U.S. National Institute of Standards Technology privacy framework, which focuses on mitigating privacy risks through engineering [11]; or the LINDDUN privacy threat modeling methodology [16]. These tools are often deductive rather than inductive, frame privacy as risk, and do not explicitly connect other values to privacy. While these tools provide mitigation strategies and techniques, they assume that privacy problems, concerns, or harms are already known and well-defined in advance, and do not assist in understanding and defining the problem space.

We suggest that design approaches can help explore and define the problem space in ways that go beyond privacy risk, leveraging recent privacy literature conceptualizing privacy as contextually dependent and subjective based on one’s subject position, rather than being objectively defined [44,46]. Mulligan and King write that privacy by design has largely not been in conversation with the insights and methods from social science and design approaches from CSCW and HCI which could help tease out nuanced understandings of privacy in relation to particular contexts, situations, or user groups [43]. While subsequent work has started to bridge these fields, such as studies of developers’ attitudes towards privacy [3], and numerous workshops exploring privacy-related methods, usable privacy interfaces, and empirical studies of users [60,63,65], there has still been a lack of methods based in critical and speculative design applied to PBD. These methods can be useful to explore, understand, and define privacy’s emerging problems spaces in ways that acknowledge privacy’s contextuality and subjectivity.

We contribute the application of critically-oriented designer-based methods to privacy by design. In particular, we use design workbooks of speculative design fictions to encourage viewers to engage in values discussions and reflection. This set of tools can be used at the beginning of a design process to provide greater reflection on values implicated in privacy concerns as part of a “holistic” approach to privacy by design.

3 USING DESIGN WORKBOOKS

We provide a brief overview of the pre-existing design workbook that our work adapts. We then discuss how we transformed the workbook from a reflective tool for researchers into artifacts to present to interviewees.

3.1 The Original Workbook

We adapt and deploy the designs from Wong, Van Wyk, and Pierce’s design workbook of sensing technology design fictions [66]. Their workbook is inspired by technologies presented in Dave Eggers’ 2013 sci-fi novel *The Circle* [18] and real-world technologies in the development stage. They use those as sources of inspiration to “jumpstart” their design process [66]. Their designs create variations on four technologies:

- **SeeChange**, from the Eggers novel, is a small camera the size of a lollipop which wirelessly records and broadcasts live HD video. It has a long battery life, can be used indoors or outdoors, mounted discretely, or worn on the body.

- **ChildTrack**, from the Eggers novel, is a small chip that can be implanted into a child's body, allowing parents to track their child's location at all times. Later in the novel, the chip's uses are expanded to store data about a child's school records and activities.
- **NeighborWatch**, from the Eggers novel, is an identity-based neighborhood watch service that automatically flags "suspicious" people. On a screen-based interface, residents who have registered their biometrics with the system display as blue figures; unregistered people in the neighborhood display as red figures.
- **Vital Radio**, a prototype developed by Adib et al. [1], uses radio waves to wirelessly detect a user's breathing and heartrate from up to 8 meters away, through walls.

Wong et al. re-imagine these four technologies throughout the workbook by placing them in different contexts, putting them in the hands of different users, or re-designing them for new purposes. For example, the designs (re)imagine ChildTrack as an academic and location-tracking service for parents, a workplace product for employers to keep track of their employees 24/7, an intimate tool for two people to share information with each other, and a platform for advertisers. These designs take several forms, such as imagined interfaces, fictional Amazon.com pages, or fictional websites. The designs are summarized in Table 1. Using Mulligan et al.'s privacy analytic framework [44], Wong et al. map their workbook's exploration of the design space along multiple dimensions of privacy; for instance what or who privacy is protecting, or what or who violates privacy. Creating the workbook helped them reflect by opening and exploring possible futures related to these sensing technologies' privacy implications.

3.2 Transforming the Design Workbook

While the original design workbook was used for reflection among a group of design researchers, we wanted to share these designs with people beyond our research team, to engage interviewees in discussions about how privacy and values relate to technical design, social norms, and other factors by using intentionally provocative speculative design fictions.

While the original workbook existed as digital images, we wanted to print the visual designs in a physical medium that interviewees could interact with. We imagined that several audiences might generatively interact with the design proposals, including engineering students, regulators, developers, or other technology professionals. Given calls to increase the diversity of design research artifacts [50] and documented complexities in negotiations between interviewers and participants when presenting speculative designs [38] we wanted to create multiple forms of the workbook, as people might interact with them differently.

Following a user centered design approach, we first brainstormed a number of ways that we might transform the workbooks for multiple audiences (Fig. 2) before choosing a few to prototype and use with interviewees. We developed three versions of the workbook: a hardcover book, a set of sketches, and a set of cards. Each version of the workbook contained the set of designs listed in Table 1.

Table 1. A summary of the designs shared with participants, sourced from [66].

Design Name	Description	Style
<i>SeeChange-inspired Designs</i>		
SeeChange Beach	Small wireless live streaming camera that can remotely monitor beaches and outdoor locations	Interface (shows a set of camera views)
SeeChange Body Camera	Small wireless live streaming camera as a police body camera that can be worn on the body	Amazon.com page
SeeChange Hideable Camera	Small wireless live streaming camera for undercover activists that can be worn on the body and is difficult for others to see	Amazon.com page
SeeChange “Survival” Camera	Small wireless live streaming camera for the protection of private property, or for anti-government activists, and is difficult for others to see	Amazon.com page
SeeChange Angles	Multiple small wireless live streaming cameras that looks at the same conference room from 9 different angles	Interface (shows a set of camera views)
<i>NeighborWatch-inspired Designs</i>		
NeighborWatch Pro	An identification system that automatically detects and flags “suspicious people” who enter a neighborhood	Product Website
Airport Security	A system that automatically detects and flags “suspicious people” by color-coding people in surveillance camera footage	Interface (shows a set of camera views)
License Plate Tracker	A system searchable by license plate number to track the location history of any vehicle	Interface
<i>ChildTrack-inspired designs</i>		
ChildTrack UI	Implanted chip that keeps track of a child’s location and educational activities	Interface (mobile app)
TruWork	Implanted chip that allows employers to keep track of employees’ location, activities, and health, 24/7	Product Website
CoupleTrack	An implanted chip that people in a relationship wear to keep track of each other’s location and activities.	Infographic advertisement
ChildTrack for Advertisers	Shows advertisers how they can make use of an implanted chip that constantly tracks a child’s location	Infographic advertisement
<i>Vital Radio-inspired designs</i>		
Grandma’s Data in Vital Radio	A wireless sensor that can detect heartbeats and breathing without bodily contact, then infer emotional state and stress levels	Interface
Vital Radio Match	An online dating service that matches people based on their “compatible heartrates”	Infographic advertisement
Amazon Echo with Vital Radio	Adds a sensor that wirelessly detects heart rate and breathing to the Amazon Echo voice assistant and speaker device, so that the Echo can take actions based on a user’s vital signals.	Amazon.com page

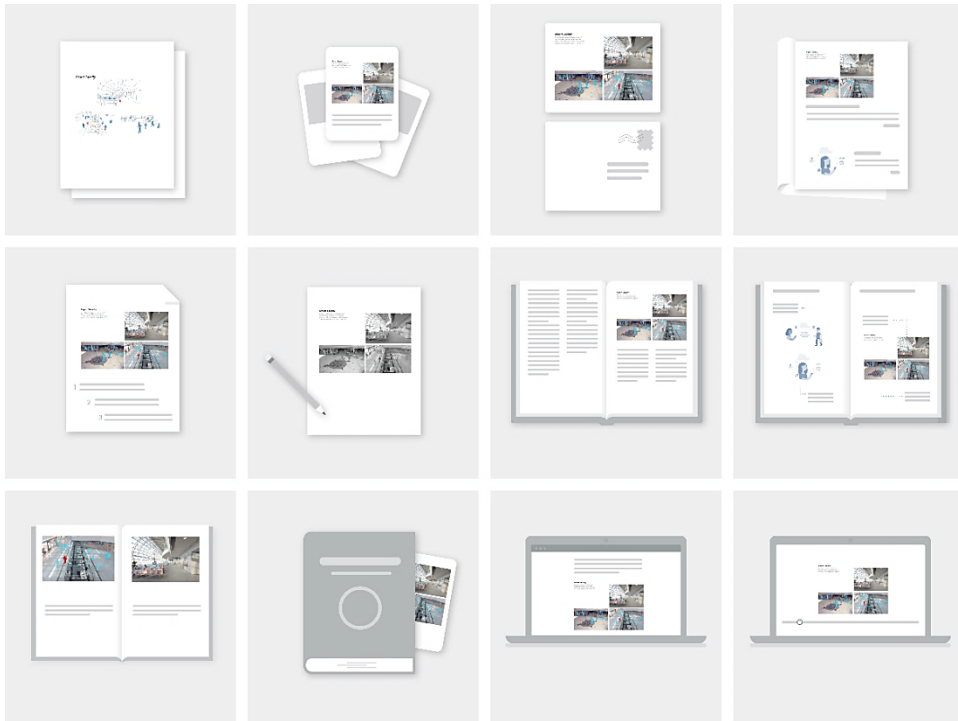


Fig. 2. Brainstormed ideas of how the design workbook might be transformed into physical artifacts. Row 1 (left to right) envisions sketched versions of the designs, cards, self-addressed postcards for people to take home, and a product catalog to envision the designs as everyday products. Row 2 shows a fictional instruction manual, a classroom worksheet for students, a textbook using the designs to discuss privacy concepts, and an illustrated guide of designs. Row 3 shows an illustrated version of *The Circle* for children, picture inserts to leave behind in library or bookstore copies of the novel, a fanfiction website, and a video prototype of the designs.

The first way we adapted the workbook was to bind the designs in a hardcover book (Fig. 3). We intentionally made the book look and feel like a professional product, using high finish images on glossy paper. The book is split into four sections based on the inspiration technologies, each section containing a text passage from *The Circle* (or with Vital Radio, a short fan-fiction passage in the style of *The Circle* [66:570]). We thought that these passages would help describe and contextualize the technologies for participants unfamiliar with *The Circle*. Image books are a relatively common format, and we hoped that this familiarity would help ground our speculative designs.

Our second transformation was to make a sketchbook, creating new mockups and hand-drawn sketch versions of the original designs printed on letter-sized paper (Fig. 4). We thought the lower fidelity of sketches might invite critiques or reflections from participants. We also thought printing sketches on plain printer paper might invite participants to draw on or annotate the sketches. The sketches were more visually abstracted and less detailed than the hardcover book. They also had less text; we did not include long passages describing the technologies. By making the sketches easy and cost-effective to re-print, we could iterate more quickly than with the hardcover book. We changed some visual elements when participants did not understand figures (e.g. thinking a silhouette of a person looked like a bear). We also changed the sketchbook's binding over time: we first created stapled sketchbooks which forced participants to look at

sketches one at a time, and later created paperclipped and unbound versions which allowed participants to look at multiple sketches simultaneously.



Fig. 3. The hardcover book shows the designs (left) and has section title pages with passages from The Circle (right)

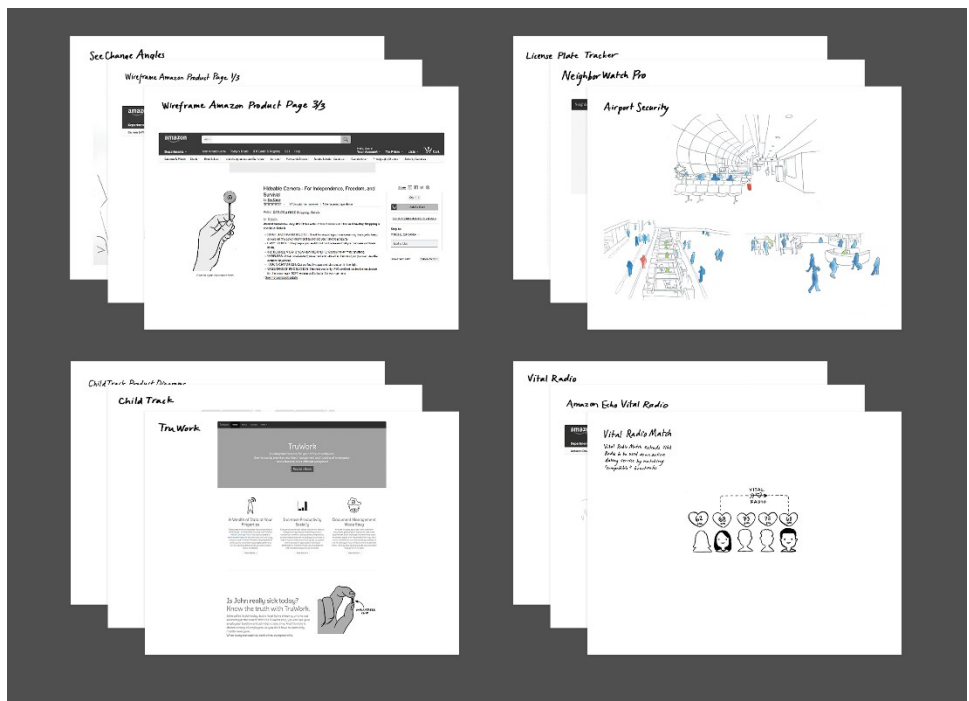


Fig. 4. Sketchbook versions of the designs



Fig. 5. Color-coded cards version of the designs.

Third, we made card versions of the designs because we thought they would allow for novel interactions: people can spread them out to make comparisons and connections between designs. Unlike the hardcover book, cards may encourage non-linear progression through the designs. We were inspired by existing cards for ideation, thinking about values, or working through technical security issues [21,36,58], although our cards present fictional products or scenarios rather than questions or prompts. Because the designs are physically smaller than the sketchbook or hardcover book, participants might spend less time reading the copy text and look more at the visuals.

The cards were printed on cardstock, approximately 5 by 7 inches. Important parts of the designs' copy or short text descriptions were printed at the bottom of the cards. Since we distinguished designs by technology type in our prior transformations, we initially color-coded the cards (SeeChange-red, NeighborWatch-orange, ChildTrack-green, Vital Radio-navy) (Fig. 5). However, we realized that participants may see different relationships between the cards unrelated to our categories. To allow us to ask participants to group cards based on their own interpretations, we created a second iteration of the cards that all used the same color (Fig. 1). Fig. 6 shows how the "SeeChange Angles" design looked across the three transformations.



Fig. 6. SeeChange Angles as depicted in the Hardcover Book (top left), Sketches (top right), and Color-coded Cards (bottom).

4 CONDUCTING INTERVIEWS

As privacy by design encourages integrating an understanding of privacy into all aspects of the design and engineering process, the ability for technology professionals—including product managers, designers, and developers—to surface, discuss, and address values becomes vital. Part of our interest also stems from a broader project researching ethical training for technology professionals. We recruited graduate students from a professionally-oriented information management program in the San Francisco Bay Area, who are training to go into technology professions such as those listed above. This population was purposefully selected given our research interests and questions. In order to talk with participants with a certain level of expertise, we recruited participants who had finished the program's required core courses (or equivalent courses), which includes technical courses and courses that address social aspects of technology. To get domain-relevant responses, we recruited participants interested in technologies that sense humans.

We met with 10 graduate students: 9 from the information program, and 1 student from a computer science program who saw our call for participation. 7 were Master's students and 3 were Ph.D. students. 6 identified as female and 4 as male. 8 participants ranged in age from 24 to 32 (average 27.9, median 27.5); 1 participant provided their age as within a range of 30-49, and 1 participant declined to state their age. Most participants had experience in a technology-related job either from before entering the graduate program, or by doing an internship while in the program.

After filling out a short demographic questionnaire, each participant was shown one version of the design workbook and looked at all the designs in an approximately 1 hour session. While we wanted to make sure that each transformation was looked at by at least 1 participant, following a quick iterative user centered design process, we did not show the transformations to participants evenly. Rather, we continued using ones that seemed more useful and generative, and discontinued or iterated on ones that became problematic (for instance we found the hardcover book difficult to use because it had the most text and took longer for the participant to go through). Our goal was not to measure significant differences between different versions, but to understand how participants used values to explore the design workbooks. 1 interviewee received the hardcover book, 6 received sketches, and 3 received cards (2 with the color-coded, and 1 with the non-color-coded).

Semi-structured interviews were conducted by 1 or 2 researchers on a university campus. Participants were compensated with a \$20 amazon.com gift card. At the start of the interview, the researchers explained that the designs were conceptual, and that while we were interested in understanding what people thought about the designs, we were not planning to develop them into products. Participants were not told that the designs were created to think about privacy. Participants were asked to "think aloud" and provide their initial thoughts as they looked through the designs and were asked periodically about their comfort with the designs, and what technical, legal, or social changes they might make to address discomforts or other issues they identified.

Interview transcripts were analyzed through several rounds of coding. We generated an initial list of codes while reviewing the data using process coding (or action coding) to identify participants' interactions with the workbooks [54:96], and values coding to identify values, attitudes, and beliefs [54:110]. These codes were refined and organized into themes based on patterns identified in the data. To understand how participants were conceptualizing privacy, we did another round of coding using Mulligan et al.'s privacy analytic framework [44], which provides multiple dimensions of privacy that can be represented in a given situation: theory (why there should be privacy), protection (who and what is protected by privacy), harm (actions and actors that violate privacy), provision (what provides privacy protection), and scope (how broadly does privacy apply). These five dimensions were used as codes. Seeing where interactions, values, and privacy dimensions overlap in the data helped us identify points when participants discussed values in relation to privacy.

5 ANALYSIS: VALUES AND PRIVACY IN WORKBOOK INTERACTIONS

We present eight themes of how participants interacted with the workbooks: seeing self as user; seeing self as professional; imagining designs as real; affective responses; comparing to present; reflecting on framing and motivations; comparing configurations; and comparing designs. While these themes are not mutually exclusive, participants' interactions while discussing values tended to be clustered around these types of actions. Specific designs referenced in this section are summarized in Table 1.

5.1 Seeing Self as User

Values were surfaced when participants imagined themselves as users (direct and indirect) of products in the workbook. P8 put herself in the subject position of working for an employer who makes employees use implantable TruWork tracking chips, reflecting on the copy text “Is John really sick today? Know the truth with TruWork.”

P8: If I called in sick to work, it shouldn't actually matter if I'm really sick. [...] There's lots of reasons why I might not wanna say, “This is why I'm not coming to work.” The idea that someone can check up on what I said—it's not fair.

In contesting TruWork's abilities to expand employers' power, P8 raises the values important to employee subjects of the product: fairness, trust, and limits on intrusion by the employer. P1 imagined herself as an indirect user of Grandma's Data in Vital Radio, imagining her grandma as the subject of Vital Radio while seeing herself as the recipient of the data. Here, P1 discussed her grandmother's consent, agency, and autonomy.

P1: In terms of emotion, breath rate, stress level, I don't know why I need to know—I can see wanting to know if grandma is alive, you know. Or if grandma's pulse is weakening, and grandma's ok with it. But something like—do I need to know grandma's happy? I mean that's her prerogative to tell me. You know, I don't need that, that to be sensed objectively.

Raising concerns about values from different subject positions surfaces how privacy harms are spread unevenly. The values also imply what gets to be or should be protected by privacy in these situations, such as fairness, the ability to separate work and home, and personal autonomy.

5.2 Seeing Self as a Professional

Participants also viewed designs through the lens of their professional practices and experiences. Some participants explicitly linked their reflections to a professional identity. When thinking about how the Airport Security design might automatically flag and detect people, P5 reflected on his self-identification as a data scientist and the values implications of predicting criminal behavior with data.

P5: The other thing, the creepy thing, the bad thing is, like—and I am a data scientist, so it's probably bad for me too, but—the data science is predicting, like *Minority Report*. Predicting whether this person—the tendency of this person to be a criminal. That would probably be bad, because you don't know if this person will be a criminal [...] You shouldn't go the *Minority Report* way, you know? Basically, you don't hire data scientists (*Laughs*)

Here P5 begins to reflect on how his practices as data scientist and his propensity to use the data to predict if data subjects are criminals might be implicated in this product's creepiness.

Similarly, P10 mentioned his experience in online advertising to discuss legal constraints surrounding the collection of children's data that would make ChildTrack for Advertisers difficult to implement. And P6 considered the notice and choice process in her prior filmmaking career (posting signs while filming on a public street) and how that might help inform notice and choice in public spaces.

Others discussed designs in relation to their technical practices. P7 compared CoupleTrack to an IOT project he was working on. When asked how his project was similar or different, he discussed the value of voluntary consent.

P7: [CoupleTrack] is very similar to our idea. We're thinking of features, except ours is not embedded in your skin. It's like an IOT charm which people [in relationships] carry around. [...] It's voluntary, and that makes all the difference. You can choose to keep it or not to keep it. [...] [If] it's like something that's under your skin, you forget about it if you're not constantly paying attention to it. A charm, that's something that's external.

Similarly, P9 discussed a wearable device that she built that created visualizations of sounds while discussing how data collected by Amazon Echo with Vital Radio could be used. Participants used their professional identities, experiences, and practices to interpret and reflect on the designs.

5.3 Imagining Designs as Real

Even though participants were aware that the designs were fictional and conceptual, they often interacted with the designs as if they were real. Some did this by trying to expand the fictional world in which the designs exist. P4, reading testimonials on the NeighborWatch Pro website began asking for more details about one of the customers, "William," who attributes the algorithmic identification system as a "fair and unbiased" way to eliminate "no good teenagers" from the neighborhood. While fairness and justice are important values, P4 suggested that the outcome that William feels is fair and just may not be the same for the banished teenagers; in this system William would not be considered a suspicious person, but might have a different opinion if he was wrongly accused as being "suspicious."

Other participants imagined the designs as real by thinking about their long term effects—how they might be adopted by users, or how they may help shape social changes over time. For instance, P5 wondered how social norms around "wrongdoing" may change if wearable livestreaming SeeChange Hideable Cameras become widely adopted.

P5: That just means that people have accepted this as a normalcy. If anyone can do it, then everyone would do it. [...] Then the definition of wrong-doing would be questioned, would be scrutinized. [...] Are the nannies picking up my children at the right time or not? The definition of wrong-doing will be challenged. If it's 59 bucks, then it'll be used for everything.

Here, P5 suggests that previously unmonitored activities would become open for surveillance and tracking in a world where the SeeChange Hideable Cameras are widespread. Imagining the designs as real allows participants to become involved in fleshing out and creating the worlds in which these designs might exist.

5.4 Affective Responses

Participants had a variety of affective responses to the designs. When participants were asked if they would make any changes to products they did not like, some felt conflicted because they did not want the design to exist at all. Suggesting a change would concede that the product could exist in some form, such as in P5's response to the SeeChange Hideable Camera and "Survival" Camera.

P5: I would not have this system. If there is something that makes me have this system, I would be—it would be much more regulated. [...] I'm trying to salvage something here and say, okay, if you put these regulations in, and people can only get these cameras in extreme cases where they petition to the government and stuff. Even then, I don't think any good will come out of providing people access to cameras and recording data.

In other designs, participants laughed or provided sarcastic responses, similar to how some of the designs intentionally exaggerated and parodied current trends:

P8: TruWork. Okay. *[Laughs]* I'm laughing at the "happier, more efficient workplace"—okay. This is, again, positioned to the person who would be doing the tracking, not the person who would be tracked.

Others immediately expressed visceral reactions upon seeing the design, often of shock or creepiness. P6's reacted to ChildTrack UI by calling it "crazy town" and "super creepy", before further explaining teenagers' need for privacy to create their own identity and suggesting that good parents should not constantly surveil their kids.

The SeeChange Angles design caused a visceral reaction in some participants. It depicts the interface of hidden wireless live streaming cameras looking at the same conference room from 9 different angles (Fig. 6). The conference room depicted in the photos in the Hardcover Book and Cards versions of the design was the same conference room where we interviewed participants. Several participants with the Hardcover Book and Cards started looking around the room when they saw the design, as if looking for the hidden cameras, whereas participants with the Sketchbook version thought design depicted a generic room.

5.5 Comparing to the Present

Many participants discussed values when drawing comparisons between the designs and the present world. Current technologies were mentioned to make sense of the designs, including GoPro cameras, Snapchat Spectacles, smartphone location tracking, and the website Nextdoor. Often these were used as cautionary tales. For instance, when looking at SeeChange Beach, P4 used Google Glass to illustrate how awareness is implicated in design choices, such as having (or not having) a blinking recording light.

Some participants referred to current social norms and legal structures that help provide privacy protections or recourse when privacy is violated. P10 discussed how the value of recourse is practiced differently based on legal jurisdiction while looking at the SeeChange-inspired designs.

P10: In California, you have to have the consent of both parties in order to record, technically. That doesn't mean people do it all the time, but their legal system currently at least, has recourse for the improper use of some of this information. [...] Something recently that came out in the U.K. and Scotland: someone installed a CCTV camera in their house. [...] They sued the person, and even though there was no proven [...] monetary harm. They still won a bunch of money, because of differences in E.U. [and] U.K. regulations versus U.S. in terms of privacy violations, where you don't have to demonstrate harm there, whereas you very clearly do here [in the U.S.].

Participants used anecdotes to draw comparisons between the designs and their own experiences or experiences of people they knew. While looking at NeighborWatch Pro, P9 recounted a story from her youth playing outside with friends at 2 a.m., asking "Isn't that also okay for teenagers to get into a little bit of trouble? That's part of growing up, right, this pushing of boundaries of yourself and societal expectations." Participants also compared the designs to fictional worlds in popular culture. Designs were compared to episodes from the speculative fiction series *Black Mirror*, the book *1984*, or the film *Minority Report*. Comparing the workbook designs to present day technologies, norms, experiences, and cultural works helps elucidate the values differences between scenarios and situations.

5.6 Reflecting On the Designs' Framings and Motivations

We intentionally shared provocative designs, and participants sometimes reflected on the designs' framings or questioned the (fictional) motivations behind the designs, highlighting how values might be embedded in these designs. While looking at TruWork, P10 found that it imagines its users in a way that minimizes their autonomy.

P10: A lot of these are just about not trusting [...]. [TruWork] really bothered me more than the others cuz it's—I can't really articulate well. [...] It basically treats the person as an algorithm who should be—whose existence should be optimized to benefit the company. It's someone else imposing their vision of optimization onto someone else's existence. I think that's maybe why that bothers me.

Participants also suggested new motivations, framings, and values for the products. P9 suggested an alternate version of NeighborWatch Pro based on communal values, using the name “Neighbor Companion” or “Neighbor Friend,” which would encourage people to invite others into their neighborhood rather than keep them out. Some participants also contested the idea that technological solutions were appropriate for the types of problems that the designs professed to solve. For instance, while looking at the SeeChange Police Body Cam, P1 suggested an improved body cam might not be the best way to promote justice.

P1: There's this like narrative around “oh all we have to do is like capture it on film and then people will care. And then they'll do something.” [...] I don't think that the issue is that people don't know about these things and just need video evidence. [...] But I think for the most part this [body camera] is not like this guarantee of justice.

Participants who reflected on the designs' motivations often did a close reading of the textual portions of the design, noting specific phrases that suggest particular motivations on the part of the products' producers. Participants linked values underlying the products' motivations to the products' design and functionality.

5.7 Comparing Configurations Within Designs

Participants compared multiple possible sociotechnical configurations within a design. One way was by comparing different ways a design might be implemented. Our workbooks describe products' functions but do not specify technical implementation details, allowing participants to imagine multiple implementations. As briefly excerpted earlier, P5 compared how the Airport Security system might flag “suspicious” people based on identifying people who have existing criminal backgrounds versus using behavioral predictors, and how fairness and presumed innocence are implicated in these two implementations.

P5: So there's two things. One can be definitive: this person is red based on criminal history. [...] The other thing, the creepy thing, the bad thing is, like—and I am a data scientist, so it's probably bad for me too, but—the data science is predicting, like *Minority Report*. Predicting whether this person—the tendency of this person to be a criminal. That would probably be bad, because you don't know if this person will be a criminal. [...] As long as the first one, where it's innocent until proven guilty, basically. If you've done something before and if you have a history [...] then this person should be red. Otherwise, there's no such thing of likeliness of being a criminal, I think. You shouldn't go the *Minority Report* way, you know?

P6 focused on the different types of data CoupleTrack might use to share between couples. She discussed the values of control and appropriateness, noting that collecting different data types could lead to different harms. She felt more comfortable sharing data about her location and biosignals,

but not her activities. Another type of configuration discussed was delegation, or how certain functionalities or responsibilities could be placed in the hands of a human or a machine. This particularly emerged in the Vital Radio-related designs, which profess to read and interpret moods and emotions.

P1: The point is you should be understanding your mood, not an algorithm. You need to learn for yourself what your signals are and what they mean and take the time to do that. So this is like actually offloading the reflection, which is the most important part of self-growth and self-regulation, onto an algorithm.

P1 and others argued that reflective tasks should not be delegated from humans to machines, discussing values of mindfulness, self-reflection, and algorithmic transparency.

5.8 Comparing Designs

Participants also highlighted values when comparing designs with each other. P4 compared CoupleTrack negatively to ChildTrack UI, noting how trust emerges differently between parents and children than between significant others, saying “I feel like within a child-parent relationship, you have almost obligated trust between parent and child. Whereas in CoupleTrack, maybe your relationship hasn’t gotten there yet where you’re completely trusting of your partner.”

While participants across all workbook types compared designs, some versions more easily allowed for physical comparisons (Fig. 7). P8, who had the hardcover book, had to flip back and forth between pages to point out differences between designs. P1’s version of the sketches was stapled, and she also had to flip back and forth to make comparisons. Later versions of the sketches were unstapled, and many participants spread them out on the table, although space became an issue after 3 or 4 pieces of paper. The cards were easier to physically spread across the table.

Participants with the Hardcover Book, Sketches, and Color-coded Cards saw the designs in the same order (as shown in Table 1), which groups the designs based on their inspiration technology. Often this led participants to make comparisons among these pre-determined groups. However, P10 received the non-color-coded cards and when asked to group the cards, he provided a different set of 7 categories: (1) Designs with “I don’t trust people” motivations; (2) Designs with “there are shady people around” motivations; (3) Designs used to surreptitiously record people; (4) Dragnet surveillance technologies without explicit contexts of use; (5) Products that use biometrics; (6) Random products that someone might use; and (7) Products that will not happen. Some of his groupings dealt with the presumed motivations behind the technologies, while others dealt with use cases, data types collected, or how realistic the designs seem. These groupings help chart out new relationships among the designs beyond those we had imagined.

6 DISCUSSION

We compare our findings to other values elicitation methods and “values levers.” We then reflect on how participants discussed privacy, lessons learned from our approach, and how speculative workbooks may be used in privacy by design practice.

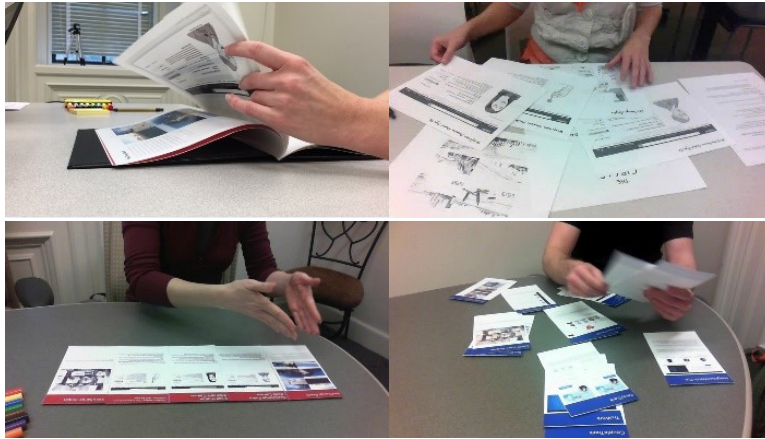


Fig. 7. A participant with the hardcover book flips pages (top left). A participant spreads sketches across the table (top right). A participant compares SeeChange-related cards (bottom left). A participant with non-colored cards arranges the cards in piles (bottom right).

6.1 Values Reflections Elicitation and Values Levers

Our speculative design workbooks share similarities with other design approaches utilized in value centered design, but add to them in several important ways. Like envisioning cards which stimulate ideation by combining cards prompting discussions about stakeholders, human values, and use and adoption [21], our participants envisioned themselves as different types of stakeholders, and walked through longer term use and adoption implications by imagining the designs as real. While our design workbook cards were similar in physical haptic form, we used cards to provide a fictional context or scenario for participants to explore and reflect on, rather than providing questions or prompts.

The workbooks also work as a set of probes [23,34] eliciting conversations about values that may prove inspirational for design, similar to other scenario- or artifact-based values in design work (e.g., [9,13,34,45,55]). However, our speculative design artifacts were created through a research through design process and were created to explicitly explore and reflect on privacy by use of a privacy analytical framework [66], before being shared with participants, giving the designs a theoretical and analytical depth specific to privacy. Furthermore, we focused our inquiry on sociotechnical systems rather than specific technologies by placing variations on four technologies in different sociotechnical configurations. Participants noticed these variations, and drew comparisons between the designs' sociotechnical configurations. The visual-textual speculative designs invited participants to expand, contest, and (re)imagine the fictional worlds in which the designs exist (imagining designs as real, and reflecting on the designs' framing and motivations). The workbook's ambiguity about implementation details allowed participants to interpret the designs in multiple ways (comparing configurations). The speculative design fictions also allowed us to have conversations about technologies that would be difficult to prototype or implement due to legal, social, or technical constraints. Lastly, while much values work focuses on engaging users, we deployed the workbooks with an expert population.

The speculative workbooks, like "values levers" identified by Shilton in her fieldwork in a collocated work setting [56], opened up discussions about values. Shilton describes effective values levers as changing the topic of conversation to foreground values, causing values to be viewed as relevant and useful to design, and leading to values-based modifications of a system [56]. While our work was conducted in a lab setting, participants centered values in their discussions, saw values as

central to design, and proposed alternative values-based implementations of the designs, suggesting that the workbooks can serve as effective values levers.

Some interactions participants had with the workbooks share similarities to Shilton's specific values levers [56]. Participants' seeing themselves as users is similar to Shilton's "experiencing internal self-testing" lever; by putting themselves in the subject position of a user, participants focused on discussing specific interactions that might cause privacy harms. Shilton also discusses a "designing around constraints" lever, that values might constrain (or help generate) designs. While our participants were not actually creating and implementing a system, they nevertheless used the workbooks designs to identify values constraints by comparing designs to the present, identifying social and legal norms. Comparing configurations suggested values tradeoffs between different technical implementations of the designs.

Two of Shilton's levers, "working on interdisciplinary teams" and "internalizing team member advocacy" arise from interpersonal interaction, in which an interdisciplinary team member or values advocate raises questions that cause the group to think about values. Our artifacts (and to some extent the interviewers) played similar roles. By depicting provocative designs that caused visceral and affective reactions, the workbooks were like actors who brought attention to and raised questions about particular sociotechnical configurations, which participants responded to with discussion about values during their initial reactions to the designs. The interviewers' follow up questions probing why participants felt a certain way helped further surface values discussions.

These findings suggest that our speculative design workbooks reflect multiple values levers in a lab interview setting. Further work might study these dynamics at a field site, investigate whether other interactions that participants had with the workbook have values levers analogs in collocated work practices, and investigate if other values levers can be translated into design approaches.

6.2 Embracing Multiple Subjectivities

We recruited our participants on the basis that they were an expert population, training to be technology professionals. However, participants played multiple roles during interviews, placing themselves in multiple subject positions in relation to the design workbooks. Sometimes participants' positions reflected their professional experience and expertise. This included referencing a professional identity, such as "data scientist" or referencing their work experiences and practices to explain their thoughts about the design. Others related the designs to technical projects that they were working on. However, participants also—and often with the same designs—discussed the designs from multiple user perspectives. As already noted, participants would imagine using the products themselves. This self-testing practice has been called "dogfooding", and suggested as a way to find bugs in development [31], and as a values lever by Shilton [56]—although assuming that developers' personal experiences match (or should match) users' experiences does not always lead to successful design outcomes [2]. Interestingly, our participants went beyond self-testing, that is, they discussed the designs from users' perspectives beyond their own. Sometimes participants discussed the designs from the perspective of a friend or relative, or from the perspective of an imagined person, like a police officer or child.

Our group of participants themselves plays multiple roles. While training to be professional experts, they are also potential future (and current) users of biosensing technologies, such as Fitbits, Apple Watches, or Snapchat Spectacles. They use, reflect, and understand—as well as design, make, and produce—both with professional skill and responsibility, and with experience as a user. In line with work on post-userism [5], the multiplicity of relations and subject positions that our participants took did not always clearly fit the categories of "user" and "designer." Being able to interpret the workbooks from multiple subjectivities aligns with the values in design goal of understanding a design from multiple stakeholders' perspectives. This is particularly useful when thinking through how privacy differs from different subject positions. While not a replacement for

user research, these reflections can help sensitize technology professionals to others' subject positions and help identify stakeholder populations to further engage with.

6.3 Reflections on Privacy

Given that recent literature conceptualizes privacy as contextual and dependent on subject position [44,46] our design workbook approach allowed viewers to imagine themselves in different subject positions and in different contexts of use. Our goal was not to extract a set of user expectations of privacy or extract a set of user requirements, but rather to understand how our participants might discuss values related to privacy and use values to reflect on the implications of different technical (and non-technical) configurations.

Our participants provided texture and nuance when describing how privacy was implicated in the designs. One way they did this was by discussing multiple dimensions of privacy. Using Mulligan et al.'s privacy analytic [44] to analyze participants' responses to the designs, we saw that the workbook designs often led participants to explicitly identify and discuss privacy harms. In discussing harms, participants often explicitly or implicitly expressed beliefs about what is protected by privacy, what provisions provide privacy, and the physical and temporal scope of privacy. After identifying a harm that violated privacy, participants discussed aspects such as contextual norms, who is being protected by privacy (and who is not), or "from whom" does privacy protect. Dimensions of privacy theory were implicitly addressed through the expression of values. For instance in discussing NeighborWatch-inspired designs, participants suggested that privacy provides justice or fair treatment to those protected by privacy; or in discussing ChildTrack UI, privacy provides children the space to develop their identities and personal autonomy.

We were surprised by some participants' emotional conflict over some of the designs, but found that these moments highlighted complex privacy issues. There were few designs that participants completely rejected or accepted; rather most participants noted positive and negative aspects, contexts, or use cases for the designs, sometimes struggling to reconcile them. For example, with many of the NeighborWatch-inspired designs, participants felt that the systems might be useful if used by experts with certain training or in circumscribed contexts, but were worried that the designs suggested that the systems were available to the general public, where abuses might occur. Others stated that prominent physical notices about data collection need be posted for the designs that take place in public spaces, but also worried that the notices would not be seen, not provide enough information for meaningful consent, or not provide a meaningful opt-out choice for users. These highlighted how privacy-related values can be expressed in multiple and conflicting ways, representing a gray area of complex and entangled issues where it can be difficult to address issues with simplistic rules (such as expecting that a rule mandating a posted notice of data collection in public spaces is enough to protect privacy). While our discussions did not lead immediately to concrete design solutions, they are useful in order to raise values as points of consideration and to identify possible points and forms of intervention where values might be addressed or implicated.

Using a set of speculative design workbooks was useful at surfacing nuanced and affective reflections along multiple dimensions of privacy. We were limited by time constraints; given fewer designs or more time with participants, we might be able to further probe and explicitly surface more of participants' views on the theory, protection, provision, and scope dimensions of privacy.

6.4 Reflections on Our Approach and Lessons Learned

We now turn to reflections and lessons learned from our work that others who deploy workbooks in privacy-related activities can use.

Creating Provocative Designs: We intentionally created provocative designs that we thought would heighten participants' awareness of privacy. Many participants had generative visceral and

affective reactions to these designs, suggesting benefits to using techniques from speculative and critical design.

We were surprised by how important the textual content of our designs was, as participants employed close reading techniques when seeing copy text in fictional product descriptions and websites. We intentionally included techno-utopian phrases in the advertisement copy and product descriptions that might heighten participants' awareness of privacy, such as a camera that "provides objective evidence of wrongdoing" or TruWork's promise to create "a happier, more efficient workplace." Participants used these phrases to comment on and contest the designs' framings and motivations. Further work might leverage research on design fictions and narratives [8] when crafting text and copy. However, there were tradeoffs, as participants took a long time to read the text. The hardcover book had the most text and took the longest for the participant to finish, thus we stopped using it after one interview. That format might be more appropriate for a different type of reflection activity that takes place over a longer period of time (such as if the participant gets to take the book home with them).

Interviewer Interactions: Interviewers helped play a role in facilitating the participants' experience. We found that not specifying how designs would be implemented allowed participants to imagine and compare possible technical implementations (in line with prior work on using ambiguity in design [25,26]). A challenge to sharing workbooks with outside audiences was that some participants approached the interviews as user tests and felt anxiety about trying to get the 'right' interpretation of the designs. We used two main strategies to try to maintain the designs' openness while reducing this anxiety. First, when participants asked, "how does this work?" we asked them to tell us multiple ways the design might work, suggesting that there was not one correct answer. This led participants to draw interesting comparisons between potential configurations of the designs. Second, we asked participants if the designs seemed similar to other products or technologies (real or fictional), resulting in participants drawing comparisons to present technologies, social norms, or personal anecdotes. These facilitation techniques helped maintain the openness of the designs. They avoided suggesting a 'right' interpretation, yet allowed participants to settle on a specific enough representation of their own to evaluate and critique the designs. Thinking through multiple implementations and multiple use cases allowed participants to think about privacy in a contextual manner [46]. Future work might explore bridging researcher-participant interactions in other ways, such as co-designing speculative workbooks.

Supporting Comparison Making: Many participants made comparisons among and between the designs to comment on differences in their framings, motivations, values, and potential privacy harms. Presenting design proposals in a set linear order (the order of Table 1) helped convey that we were depicting design variations on a set of four technologies. However, being able to physically re-arrange designs, such as the Sketches and the Cards, made it easier for participants to draw comparisons. In particular, the Non-color-coded Cards allowed P10 to organize and compare designs in different groupings than we had imagined beforehand. Randomizing the presentation order and presenting the designs in a way that do not suggest pre-determined groupings may help elicit new interpretations, values, and relationships that the designers do not foresee. Furthermore, creating design variations that vary sociotechnical configurations, rather than just focusing on technologies, helped encourage participants to compare differences in social norms and values.

Managing Real-Fictional Entanglements: While it is important for viewers to be able to *imagine* the designs as real, these designs are not early drafts of actual products. In this sense, the workbook of speculative design fictions serves as a useful research product [48]. These designs do not need to be developed into commercial products; their purposes are to serve as probes to explore a problem space by envisioning multiple futures, and to elicit values reflections from professionals. Even though the designs were fictional, we wanted participants to imagine them as real products, so we visually and textually grounded them in familiar contexts (such as airports, education, or the workplace). While this was generally successful, some designs stretched their disbelief. One

participant dismissed ChildTrack for Advertisers, saying that it would “never happen” due to child privacy laws and attitudes towards implantable technologies. Several felt that Vital Radio Match’s claims to match couples based on heartbeat had no discernable basis in scientific evidence. Future work might further this by encouraging participants to *experience* the designs as real, perhaps as speculative enactments [19].

Study Limitations: We note that there are some limitations to our study. Our participant population of future technology professionals was drawn from a graduate program that provides interdisciplinary training. Future work can inquire if sharing the workbook with technology professionals from different disciplinary backgrounds or if integrating this workbook process into design practices will lead to the same types of results.

6.5 Workbooks in Practice: Towards Privacy By Design

While the laboratory study setting, graduate student subject pool, and focus on multiple fictional designs rather than a specific product’s design process limit the ability to generalize about our findings, we postulate that our workbook process could fit into product development workflows. First, increasing regulatory demand for “privacy by design” has companies searching for meaningful methods to address privacy during the design process. Second, our workbook process bears some similarities to existing design practices.

Pressures external to companies suggest greater impetus to identify and address privacy during the design process. In the E.U., “Privacy by Design” is a principle written into the General Data Protection Regulation [27], meaning that businesses are under an obligation to consider data privacy at the initial design stages of a project. In the U.S., the Federal Trade Commission—the major regulatory agency addressing consumer privacy—has also embraced privacy by design in its recommendations to businesses and policymakers [20,33]. Ongoing efforts by organizations like the U.S. National Institute of Standards and Technology and the Computing Community Consortium to translate privacy by design into technical practice [11,14] suggest a shift in expectations that companies should address privacy issues throughout the design process.

Some publicly available work discussing companies’ design processes suggests ways in which privacy-focused speculative design workbooks might fit into existing practices and workflows. Our view of workbooks being useful to deploy even if they do not represent actual products under development is similar to IDEO’s method of “sacrificial concepts”—ideas that “do not need to be feasible, viable, or possible,” but are used as probes to start conversations when conducting early user research interviews [35]. Our design workbook approach might fit well into an organization already using sacrificial concepts as part of their user research workflow: sacrificial concepts might be repackaged into speculative design workbooks to be shared among internal stakeholders like developers during early ideation stages. Other card-based practices stemming from industry such as Google’s Moving Context Kit [47] and Microsoft’s Elevation of Privilege cards [58] use design-inspired practices to think through risks, harms, and problems in future scenarios. These existing practices suggest possible openings for additional forward-thinking tools that focus on issues of privacy. While not a replacement for empirical user research, speculative design workbooks can be especially useful at this stage, as the workbook allows exploration of many possible futures, (including those that may not be feasible to physically prototype due to resource, technical, or legal constraints) while still being grounded within specific contexts and situations. Furthermore, design workbooks may function as boundary objects, serving multiple communities [59]. This can be useful because privacy by design suggests that responsibility for privacy should be shared by stakeholders across an organization. While we shared our workbooks with technology professionals, future work may investigate how the same workbooks can be used with other stakeholders such as potential users, a company’s legal team, or with privacy advocates.

Eliciting values discussions with professionals is useful to reflect on the values and privacy implications of their practice. For those who do not directly interact with users, this process may help sensitize them to multiple users' viewpoints by inviting them to take multiple subject positions in relation to a design concept. However, workbooks and the reflections they enable by themselves are not a panacea for addressing privacy. Further strategies that might leverage these values reflections and discussions include implementing organizational procedures support discussions about values, or creating roles for privacy advocates or values advocates (e.g. [4,56]).

7 CONCLUSIONS AND FURTHER WORK

This paper has documented a case study showing how design workbooks can be adapted from a self-reflective tool to a values elicitation tool, engaging future technology professionals in interviews to discuss and reflect on values. This case study also suggests that designers and design approaches—specifically, speculative designs and design fictions presented in a design workbook—can both ground discussions about privacy and help institutions to “look around corners”—an important component of privacy work according to chief privacy officers [4]. This contributes a speculative design inspired approach to a growing body of CSCW work investigating how technology professionals can envision and respond to emerging networked privacy issues. It also offers a glimpse of the potential utility of design tools to the privacy by design agenda—an agenda in which designers and design tools have been largely absent.

In future work, we would like to see how technology professionals from other disciplinary backgrounds interact with the design workbooks. We are also interested in how these workbooks can be created, presented, and deployed by designers as part of product design processes and practices. By engaging in imagining and reflecting on multiple possible futures, technology professionals can play a role in identifying how values-laden design decisions may lead to futures that we want, and conversely, futures that we may want to avoid.

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REFERENCES

- [1] Fadel Adib, Hongzi Mao, Zachary Kabelac, Dina Katabi, and Robert C Miller. 2015. Smart Homes that Monitor Breathing and Heart Rate. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15)*. ACM, New York, NY, 837–846. DOI: <https://doi.org/10.1145/2702123.2702200>
- [2] Morgan G. Ames. 2015. Charismatic Technology. In *5th Decennial Aarhus Conference on Critical Alternatives (AA '15)*. Aarhus University Press. DOI: <https://doi.org/10.7146/aahcc.v1i1.21199>
- [3] Oshrat Ayalon, Eran Toch, Irit Hadar, and Michael Birnhack. 2017. How Developers Make Design Decisions about Users' Privacy: The Place of Professional Communities and Organizational Climate. In *Companion of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17 Companion)*. ACM, New York, NY, 135–138. DOI: <https://doi.org/10.1145/3022198.3026326>
- [4] Kenneth A. Bamberger and Deidre K. Mulligan. 2011. Privacy on the Books and on the Ground. *Stanford Law Review* 63 (Jan. 2011), 247–316.

- [5] Eric P S Baumer and Jed R Brubaker. 2017. Post-userism. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, 6291–6303. DOI: <https://doi.org/10.1145/3025453.3025740>
- [6] Jane Bennett. 2010. *Vibrant Matter: A Political Ecology of Things*. Duke University Press, Durham.
- [7] Julian Bleecker. 2009. Design Fiction: A Short Essay on Design, Science, Fact and Fiction. Retrieved from <http://www.nearfuturelaboratory.com/2009/03/17/design-fiction-a-short-essay-on-design-science-fact-and-fiction/>
- [8] Mark Blythe. 2017. Research Fiction: Storytelling, Plot and Design. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, 5400–5411. DOI: <https://doi.org/10.1145/3025453.3026023>
- [9] Kirsten Boehner, Shay David, Joseph “Jofish” Kaye, and Phoebe Sengers. 2005. Critical technical practice as a methodology for values in design. *CHI'05 Workshop*.
- [10] Pam Briggs and Lisa Thomas. 2015. An Inclusive, Value Sensitive Design Perspective on Future Identity Technologies. *ACM Transactions on Computer-Human Interaction* 22, 5, Article 23 (August 2015), 28 pages. DOI: <https://doi.org/10.1145/2778972>
- [11] Sean Brooks, Michael Garcia, Naomi Lefkowitz, Suzanne Lightman, and Ellen Nadeau. 2017. An introduction to privacy engineering and risk management in federal systems. National Institute of Standards and Technology, Gaithersburg, MD. DOI: <https://doi.org/10.6028/NIST.IR.8062>
- [12] Ann Cavoukian. 2012. Privacy by Design - The 7 Foundational Principles. Information and Privacy Commissioner of Ontario.
- [13] EunJeong Cheon and Norman Makoto Su. 2017. Configuring the User: “Robots have Needs Too.” In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17)*. ACM, New York, NY, 191–206. DOI: <https://doi.org/10.1145/2998181.2998329>
- [14] Computing Community Consortium (CCC). 2015. Privacy by Design - State of Research and Practice. Retrieved May 7, 2017 from <http://cra.org/ccc/events/pbd-state-of-research-and-practice/>
- [15] Scott Davidoff, Min Kyung Lee, Anind K Dey, and John Zimmerman. 2007. Rapidly Exploring Application Design Through Speed Dating. In *International Conference on Ubiquitous Computing (UbiComp 2007)*. Springer-Verlag, Berlin, 429–446.
- [16] DistriNet. 2014. LINDDUN Privacy Threat Modeling. Retrieved April 27, 2017 from <https://distrinet.cs.kuleuven.be/software/linddun/index.php>
- [17] Anthony Dunne and Fiona Raby. 2013. *Speculative Everything*. The MIT Press, Cambridge, Massachusetts.
- [18] Dave Eggers. 2013. *The Circle*. McSweeney’s Books, San Francisco.
- [19] Chris Elsdén, David Chatting, Abigail C. Durrant, Andrew Garbett, Bettina Nissen, John Vines, and David S. Kirk. 2017. On Speculative Enactments. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17)*. ACM, New York, NY, 5386–5399. DOI: <https://doi.org/10.1145/3025453.3025503>
- [20] Federal Trade Commission (FTC). 2012. Protecting Consumer in an Era of Rapid Change: Recommendations for businesses and policymakers. 1–112. Retrieved September 20, 2016 from <https://www.ftc.gov/sites/default/files/documents/reports/federal-trade-commission-report-protecting-consumer-privacy-era-rapid-change-recommendations/120326privacyreport.pdf>
- [21] Batya Friedman and David Hendry. 2012. The envisioning cards: a toolkit for catalyzing humanistic and technical imaginations. In *Proceedings of the 2012 ACM annual conference on Human Factors in Computing Systems (CHI '12)*. ACM, New York, NY, 1145–1148. DOI: <https://doi.org/10.1145/2207676.2208562>
- [22] Batya Friedman, Peter H. Kahn, and Alan Borning. 2008. Value Sensitive Design and Information Systems. In *The Handbook of Information and Computer Ethics*, Kenneth Einar Himma and Herman T. Tavani (eds.). John Wiley & Sons, Inc., 69–101.
- [23] Bill Gaver, Tony Dunne, and Elena Pacenti. 1999. Cultural probes. *interactions* 6, 1: 21–29. DOI: <https://doi.org/10.1145/291224.291235>
- [24] Bill Gaver and Heather Martin. 2000. Alternatives: exploring information appliances through conceptual design proposals. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems (CHI '00)*. ACM, New York, NY, 209–216. DOI: <https://doi.org/10.1145/332040.332433>
- [25] William Gaver. 2011. Making spaces: how design workbooks work. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11)*. ACM, New York, NY, 1551–1560. DOI: <https://doi.org/10.1145/1978942.1979169>
- [26] William W. Gaver, Jacob Beaver, and Steve Benford. 2003. Ambiguity as a resource for design. In *Proceedings of the conference on Human factors in computing systems (CHI '03)*. ACM, New York, NY, 233–240. DOI: <https://doi.org/10.1145/642611.642653>
- [27] General Data Protection Regulation (GDPR). 2016. Article 25: Data protection by design and by default. Retrieved May 7, 2017 from <https://gdpr-info.eu/art-25-gdpr/>
- [28] David Graeber. 2001. Three Ways of Talking about Value. In *Toward an Anthropological Theory of Value: The False Coin of Our Own Dreams*. Palgrave Macmillan, New York.
- [29] Seda Gürses, Carmela Troncoso, and Claudia Diaz. 2011. Engineering Privacy by Design. In *International Conference on Privacy and Data Protection*.

- [30] Munawar Hafiz. 2006. A collection of privacy design patterns. In *Proceedings of the 2006 conference on Pattern languages of programs (PLoP '06)*. ACM, New York, NY, Article 7, 13 pages. DOI: <https://doi.org/10.1145/1415472.1415481>
- [31] Warren Harrison. 2006. Eating Your Own Dog Food. *IEEE Software* 23, 3: 5–7. DOI: <https://doi.org/10.1109/MS.2006.72>
- [32] Justin Hemmings, Marie Le Pichon, and Peter Swire. 2015. Privacy by Design - Privacy Enabling Design, Workshop 2 Report. Retrieved September 20, 2016 from <http://cra.org/ccc/wp-content/uploads/sites/2/2015/05/PbD2-Report-v5.pdf>
- [33] Chris Jay Hoofnagle. Online privacy. In *Federal Trade Commission Privacy Law and Policy*. Cambridge University Press, Cambridge, 145–192. DOI: <https://doi.org/10.1017/CBO9781316411292.007>
- [34] Hilary Hutchinson, Heiko Hansen, Nicolas Roussel, Björn Eiderbäck, Wendy Mackay, Bosse Westerlund, Benjamin B. Bederson, Allison Druin, Catherine Plaisant, Michel Beaudouin-Lafon, Stéphane Conversy, and Helen Evans. 2003. Technology probes. In *Proceedings of the conference on Human factors in computing systems (CHI '03)*. ACM, New York, NY, 17–24. DOI: <https://doi.org/10.1145/642611.642616>
- [35] IDEO. Human Centered Design Toolkit. 2nd Edition. Retrieved May 7, 2017 from https://climateandhealthresearch.files.wordpress.com/2015/04/ideo-org_hcd_toolkit.pdf
- [36] IDEO. 2003. Method Cards. Retrieved January 15, 2017 from <https://www.ideo.com/us/post/method-cards>
- [37] Nassim JafariNaimi, Lisa Nathan, and Ian Hargraves. 2015. Values as Hypotheses: Design, Inquiry, and the Service of Values. *Design Issues* 31, 4: 91–104. DOI: https://doi.org/10.1162/DESI_a_00354
- [38] Vera Khovanskaya, Eric P. S. Baumer, and Phoebe Sengers. 2015. Double Binds and Double Blinds: Evaluation Tactics in Critically Oriented HCI. In *The Fifth Decennial Aarhus Conference on Critical Alternatives (AA '15)*. Aarhus University Press, 53–64. DOI: <https://doi.org/10.7146/aahec.v1i1.21266>
- [39] Cory Knobel and Geoffrey C. Bowker. 2011. Values in design. *Communications of the ACM* 54, 7 (July 2011). DOI: <https://doi.org/10.1145/1965724.1965735>
- [40] Bruno Latour. 1992. Where are the missing masses? The sociology of a few mundane artifacts. In *Shaping Technology/Building Society: Studies in Sociotechnical Change*, Wiebe Bijker and John Law (eds.). MIT Press, 225–258.
- [41] Joseph Lindley and Paul Coulton. 2015. Back to the Future: 10 Years of Design Fiction. In *Proceedings of the 2015 British HCI Conference (British HCI '15)*. ACM, New York, NY, 210–211. DOI: <https://doi.org/10.1145/2783446.2783592>
- [42] Nick Merrill and Coye Cheshire. 2017. Trust Your Heart: Assessing Cooperation and Trust with Biosignals in Computer-Mediated Interactions. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17)*. ACM, New York, NY, 2–12. DOI: <https://doi.org/10.1145/2998181.2998286>
- [43] Deirdre K. Mulligan and Jennifer King. 2011. Bridging the gap between privacy and design. *University of Pennsylvania Journal of Constitutional Law* 14 (2011), 989–1034.
- [44] Deirdre K. Mulligan, Colin Koopman, and Nick Doty. 2016. Privacy is an essentially contested concept: a multi-dimensional analytic for mapping privacy. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 374, 2083 (Dec. 2016). DOI: <https://doi.org/10.1098/rsta.2016.0118>
- [45] Lisa P. Nathan, Batya Friedman, Predrag Klasina, Shaun K. Kane, and Jessica K. Miller. 2008. Envisioning systemic effects on persons and society throughout interactive system design. In *Proceedings of the 7th ACM Conference on Designing Interactive Systems (DIS '08)*. ACM, New York, NY, 1–10. DOI: <https://doi.org/10.1145/1753846.1754003>
- [46] Helen Nissenbaum. 2009. *Privacy in Context: Technology, Policy, and the Integrity of Social Life*. Stanford University Press, Stanford, California.
- [47] Katie O'Leary, Tao Dong, Julia Katherine Haines, Michael Gilbert, Elizabeth F Churchill, and Jeffrey Nichols. 2017. The Moving Context Kit: Designing for Context Shifts in Multi-Device Experiences. In *Proceedings of the 2017 Conference on Designing Interactive Systems (DIS '17)*. ACM, New York, NY, 309–320. DOI: <https://doi.org/10.1145/3064663.3064768>
- [48] William Odom, Ron Wakkary, Youn-kyung Lim, Audrey Desjardins, Bart Hengeveld, and Richard Banks. 2016. From Research Prototype to Research Product. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16)*. ACM, New York, NY, 2549–2561. DOI: <https://doi.org/10.1145/2858036.2858447>
- [49] 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 the Designing Interactive Systems Conference (DIS '12)*. ACM, New York, NY, 338–347. DOI: <https://doi.org/10.1145/2317956.2318008>
- [50] James Pierce. 2014. On the presentation and production of design research artifacts in HCI. In *Proceedings of the 2014 conference on Designing interactive systems (DIS '14)*. ACM, New York, NY, 735–744. DOI: <https://doi.org/10.1145/2598510.2598525>
- [51] 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 the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15)*. ACM, New York, NY, 2083–2092. DOI: <https://doi.org/10.1145/2702123.2702438>
- [52] Sasha Romanosky, Alessandro Acquisti, Jason Hong, Lorrie Faith Cranor, and Batya Friedman. 2006. Privacy patterns for online interactions. In *Proceedings of the 2006 conference on Pattern languages of programs (PLoP '06)*.

- ACM, New York, NY, Article 12, 9 pages. DOI: <https://doi.org/10.1145/1415472.1415486>
- [53] Ira S. Rubinstein and Nathaniel Good. 2013. Privacy by Design: A Counterfactual Analysis of Google and Facebook Privacy Incidents. *Berkeley Technology Law Journal*, 28, 2 (2013). DOI: <https://doi.org/10.15779/Z38G11N>
 - [54] Johnny Saldaña. 2013. *The Coding Manual for Qualitative Researchers*. Sage, Los Angeles.
 - [55] Phoebe Sengers, Kirsten Boehner, Shay David, and Joseph Jofish Kaye. 2005. Reflective Design. In *4th decennial conference on Critical computing: between sense and sensibility (CC '05)*, 49–58. DOI: <https://doi.org/10.1145/1094562.1094569>
 - [56] Katie Shilton. 2013. Values Levers. *Science, Technology, & Human Values* 38, 3: 374–397. DOI: <https://doi.org/10.1177/0162243912436985>
 - [57] Katie Shilton, Jes A. Koepfler, and Kenneth R. Fleischmann. 2014. How to see values in social computing: Methods for Studying Values Dimensions. In *Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing (CSCW '14)*. ACM, New York, NY, 426–435. DOI: <https://doi.org/10.1145/2531602.2531625>
 - [58] Adam Shostack. 2014. Elevation of Privilege: Drawing Developers into Threat Modeling. In *USENIX Summit on Gaming, Games, and Gamification in Security Education*, 1–15.
 - [59] Susan Leigh Star and James R. Griesemer. 1989. Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39. *Social Studies of Science* 19, 3: 387–420. DOI: <https://doi.org/10.1177/030631289019003001>
 - [60] Luke Stark, Jen King, Xinru Page, Airi Lampinen, Jessica Vitak, Pamela Wisniewski, Tara Whalen, and Nathaniel Good. 2016. Bridging the Gap between Privacy by Design and Privacy in Practice. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '16)*. ACM, New York, NY, 3415–3422. DOI: <https://doi.org/10.1145/2851581.2856503>
 - [61] Peter Tolmie, Andy Crabtree, Tom Rodden, James A Colley, and Ewa A Luger. 2016. "This has to be the cats" - Personal Data Legibility in Networked Sensing Systems. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing (CSCW '16)*. ACM, New York, NY, 490–501. DOI: <https://doi.org/10.1145/2818048.2819992>
 - [62] U.S. Department of Homeland Security. 2010. Privacy Impact Assessments: The Privacy Office Official Guidance (June 2010). Retrieved January 1, 2017 from https://www.dhs.gov/sites/default/files/publications/privacy_pia_guidance_june2010_0.pdf
 - [63] Jessica Vitak, Pamela Wisniewski, Xinru Page, Airi Lampinen, Eden Litt, Ralf De Wolf, Patrick Gage Kelley, and Manya Sleeper. 2015. The Future of Networked Privacy: Challenges and Opportunities. In *Proceedings of the 18th ACM Conference Companion on Computer Supported Cooperative Work & Social Computing (CSCW'15 Companion)*. ACM, New York, NY, 267–272. DOI: <https://doi.org/10.1145/2685553.2685554>
 - [64] Langdon Winner. 1980. Do Artifacts Have Politics? *Daedalus* 109, 1: 121–136.
 - [65] Pamela Wisniewski, Jessica Vitak, Xinru Page, Bart Knijnenburg, Yang Wang, and Casey Fiesler. 2017. In Whose Best Interest? Exploring the Real, Potential, and Imagined Ethical Concerns in Privacy-Focused Agenda. In *Companion of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (CSCW '17 Companion)*. ACM, New York, NY, 377–382. DOI: <https://doi.org/10.1145/3022198.3022660>
 - [66] Richmond Y. Wong, Ellen Van Wyk, and James Pierce. 2017. Real-Fictional Entanglements: Using Science Fiction and Design Fiction to Interrogate Sensing Technologies. In *Proceedings of the 2017 ACM Conference on Designing Interactive Systems (DIS '17)*. ACM, New York, NY, 567–579. DOI: <https://doi.org/10.1145/3064663.3064682>
 - [67] John Zimmerman, Jodi Forlizzi, and Shelley Evenson. 2007. Research through design as a method for interaction design research in HCI. In *Proceedings of the SIGCHI conference on Human factors in computing systems (CHI '07)*. ACM, New York, NY, 493–502. DOI: <https://doi.org/10.1145/1240624.1240704>

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