

# Extensions, Responses, and Interjections

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## Abstract

As the field of science and technology studies (STS) gradually integrates experimental and collaborative approaches, it faces new possibilities for exploring the shifting significance and materiality of technological practices. To help us characterize this work, we present case studies examining three ways of studying practices of technoscience through design projects: *responses* that foreground sociotechnical counter-narratives; *extensions* that amplify dominant sociotechnical logics; and *interjections* that refigure sociotechnical practice. Each of these approaches to intervention draws on design-lead forms of inquiry such as critical, adversarial and speculative design/making (DiSalvo 2012; Dunne and Raby 2014; Ratto 2011) to generate fresh understandings of design products and practices. In reflecting on our own case studies we show how STS can help develop a more socially informed design process, and how design could help clarify STS investigation. We demonstrate what it might mean to do sociotechnical inquiry with and through design: how design can open up creative possibilities overlooked by other modes of investigation, and help STS researchers communicate in the field; and how STS can reveal design as part of local improvisations, partial connections and located accountabilities (Strathern 2005; Suchman 2011).

## Introduction

The Block Party at the 2015 Seattle Design Festival “Design for Equity” crowded with visitors from across the Puget Sound. Designers from architecture consultancies, non-profit firms, and state-run universities furnished public installations from discarded objects, whether busted skateboards or beat up pots and pans. Reworking these broken materials over hundreds of volunteer hours, they produced sustainable furniture and accessible prototyping tables. One group from the University of Washington unveiled their “Universal Play Kiosk,” three desks encircling a curb-cut platform that could flexibly adjust to the height and position of a surrounding audience (Fieldnotes, August 2015). For those with limited mobility — including people in wheelchairs, strollers or standers — the desks offered a means of collaborating in the development of computing devices by allowing each person to see one another, work with the table tops regardless of the person’s positioning, and move to the middle of the platform — in the team’s words, “take center stage” (Caspi 2015).

In this appeal to the imagery and practice of design, the Kiosk designers and other Block Party participants aimed to do something more than advance public participation in design. They took up design as performance. This meant viewing design as a stage for not only activism but also inquiry, inviting attendees to question the ethical, political and socioeconomic circumstance of technology development. So doing, they linked design to

an emerging field of technology studies wherein *doing* and *making* have come to complement (and extend) social inquiry.

For many scholars of science and technology studies (STS), the Block Party and other theaters of design practice provide a fruitful object of study. From printable prosthetics to portable water pumps, design projects shape the connections people make, the spaces they move through, and the socio-political infrastructures they inhabit (De Laet and Mol 2004, Junknickel 2014; Suchman 2014). A study of these processes might focus on the priorities of those living with small-scale manufacturing or the organization of 'downstream' networks of maintenance and repair (Cheattle and Jackson 2015, Jackson et al. 2012, Rosner and Turner 2015). A study of design could equally call for highlighting the material dimensions of digital engagements by following the digital traces they leave behind (Blanchette 2011, Geiger & Ribes 2011): studying the pervasive distinction between digital books, for example, versus physical books, or people's experiences of point-by-point walking routes in relation to wandering.

But what happens when a design project, as a form of technological work, becomes a mode of inquiry? Like our designers of the kiosk, recent developments in STS present some clues. As forms of participatory or cooperative design, design activity has charted new paths for the understanding of technical work. Some have devised "inventive" methods (Lury and Wakeford 2013) such as workshops, films, and performances to investigate and reimagine the promise of IT. Termed critical, speculative or adversarial design (Dunne and Raby 2001, 2013; DiSalvo 2012; Bardzell & Bardzell 2013), this work questions dominant logics of high tech cultures while reworking the constraints of digital investigation (Jackson and Kang 2014, Geiger and Ribes 2011). Across these organizational 'seams' (Vertesi 2014), projects entangle methods and objects of inquiry — "both made and in the making" (Suchman 2013) through technoscience.

This chapter builds on a recent turn to design-based modes of inquiry (Lury and Wakeford 2013; Ratto 2011; DiSalvo 2012) to characterize what it means to examine digital practices through design: how design can open up creative possibilities overlooked by other modes of investigation, and help STS researchers communicate in the field; and how STS can unlock ethical and political dimensions of design. To do this we draw from a strand of STS often called feminist technoscience (Suchman 1994, 2000, 2011, Barad 2008, Strathern 2005, Law 2004). Intersecting with the field of design, this program of work often surfaces the ethical, political and institutional arrangements in which design practices unfold. For example, Suchman's (2000) concern for "located accountabilities," the different contingencies and responsibilities entailed in design, help her reconceptualize the role of the designer as dynamic and co-constructive of design practices. Through surfacing these accountabilities, she emphasizes the social relations making up technology work of which the designer is an active part. Suchman contrasts this term with a "detached intimacy" (a relationship to technology work that remains cut-off and self-referential) and Haraway's concern for a "view from nowhere" (a tendency to overlook the designers' own place within the sociotechnical work they do). A second concept from feminist science studies influential in our analysis concerns "partial connections," which Strathern and Haraway use to highlight the difference limitations of knowledges while acknowledging their commonalities, such as the status of women or people of color with different degrees of

socioeconomic privilege and marginality. Bringing these theoretical concerns together with our projects of design inquiry — and reading each through the other — helps to rewrite the relationship between designer, user, and technology as dynamic and relational. How does design configure categories of use, hacking or repair? What happens when we think about technological developments from the perspective of those “who don’t fit but can’t just walk away?” (Nakamura and Haraway 2003) In addressing these questions, we find the performativity of our methods central to our analysis, as the work of Lury and Wakeford (2013) and John Law (2004) would have us accept.

The following conceptualizations of design in STS contribute to conversations on method. In particular, we use design processes — already locally and globally contingent — to help us imagine, in the words of John Law (2004, p.7), “what research methods might be if they were adapted to a world that included and knew itself as tide, flux, and general unpredictability.” This suggests possibilities for not only extending STS approaches through design, but also enrolling technoscientific practices in clarifying conceptual questions. Moving away from metaphors of ‘knowing’ toward notions of ‘doing’ enables different concerns for embodiment, emotionality, and situated inquiry otherwise overlooked (Law 2004).<sup>1</sup>

In the sections that follow we present case studies that broaden our concerns for technological knowledge practices by enumerating three ways of doing STS as design inquiry. Firstly, designed *responses* introduce technological counter-narratives to examine the limits and possibilities of underpinning ideas. Secondly, *extensions* enable researchers to provoke reflection on particular sociotechnical logics by enhancing technical configurations. Lastly, *interjections* transform practices underlying technology projects to consider alternative benefits and risks. Each of our cases draws on forms of critical design/making (DiSalvo 2012; Dunne and Raby 2014; Ratto 2011) to describe and shape the symbolic work of design. The goal of this work is not to offer a universal model for STS. Instead, we provide three among many possible ways of investigating the present circumstance of technology develop and its institutional arrangements. So doing, we relate digital STS concerns to some of the generative and experimental undercurrents of design inquiry (Lury and Wakeford 2013; Ratto 2011; DiSalvo 2012).

### **Knowing Design**

Locating interventionist projects in a wider program of inquiry requires first considering definitions of design. On the one hand, design has become a promising foil for exploring interdisciplinary knowledge practices. In the 1920s, Bauhaus artists envisioned industrial manufacturing techniques as modes of interweaving traditionally distinct craft skills, broadening the industrial imagination to develop new kinds of people (Turner 2013). Richard Bach, a Director of Industrial Relations at the Metropolitan Museum of Art, designated the emerging designer a “personality,” no longer anonymous like a cog on a machine (Bach 1930 p.220). By the 1970s, renowned designers Charles and Ray Eames had

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<sup>1</sup> Law (2004) argues in *After Method* many social phenomena are entirely missed by empirical social science methods of observation, participation, controlled experiments or survey research in part due to their complexity. He writes, “events and processes are not simply complex in the sense that they are technically difficult to grasp (though this is certainly often the case). Rather, they are also complex because they necessarily exceed our capacity to know them” (Law 2004:6).

become, according to media historian Fred Turner (2012, p.397), “entranced” with multi-disciplinary cybernetic theories of individual empowerment through networked systems. Ray Eames described all things — chairs, buildings, multimedia — as architectural structures that acknowledge “a kind of analysis, as well as a kind of tradition behind it” (Gingerich and Eames 1977: 327). This turned to systems theory echoed a call for a science of design often traced to Herbert Simon’s *The Sciences of the Artificial* (1969). In this treatise, Simon notoriously defined design as “devis[ing] courses of action aimed at changing existing situations into preferred ones” (ibid, p.111). Under this understanding of design, the work that comes from “soft, intuitive, informal, and cook-booky” (ibid, p.112) judgment should dissolve in favor of “a body of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process” (Simon 1969, p. 113, also quoted in Suchman 2011, p.5). Today institutions like Stanford’s Institute of Design (or d.school) continue to espouse aspects of this doctrine (Ames et al. 2015). Adopting the term “design” as a progressive ideal, they liberate aspiring engineers from disciplinary constraint and “soft” judgment, be it carpentry or software development (see Ames et al. 2015).

On the other hand, oppositional views on design’s liberating potential have positioned design methods as instruments of activism and disruption (Ames et al 2015, Balsamo 2011, Dunne and Raby 2013, Marres 2013, Margolin 2002). Victor Margolin (2002) discusses the systems thinking that underpins Simon’s treatment of design (“privileg[ing...] efficiency as a way of judging the effectiveness of design thought” (ibid, p.237)) to suggest designers should focus instead on the historical and political circumstances through which design practices get made (ibid, 241). Other work draws on American pragmatist and closely connected ethnomethodological traditions. Sociologist Noortje Marres (2012, 2013), for example, recommends considering material participation, the “normative” actions by which objects, systems and infrastructure configure participation in democratic life. In other work she draws connections between material interventions and the ethnomethodological demonstrations of breaching experiments, the famous sociological disruptions that Harold Garfinkle and his colleagues performed in the 1960s. Marres describes Spiral Drawing Surprise, a ‘sustainable living experiment’ that introduced a solar powered robot cart into a public square, revealing a ‘routine environment’ as a space of movement choreographed by the sun. Sociologist Andy Crabtree similarly connects prototyping practices with social disruptions forged through purposefully shifting intimate relations. For Crabtree, technological innovations resemble breaching experiments in their capacity to “provoke (in the etymological sense of ‘call forth’) practice and make it visible and available design reasoning” (Crabtree 2004 p.60).<sup>2</sup> A parallel strand of work building on feminist science studies scholarship highlights the ethics and politics of design in society. Ames et al. (2015) describe classes on ‘design thinking’ that gather vastly different strands of thought, from psychology to art practice, as practices of technological

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<sup>2</sup> At the interface of these perspectives lives a broad and varied scholarship on research-through-design that we lack the space to elaborate here. Exploring the extension of ‘human-centered’ approaches, some scholars turn cycles of observation, ideation, prototyping, and testing into design recommendations and guidelines (Koskinen et al. 2011, Forlizzi et al. 2009, Zimmerman et al. 2007). Others favor studies of design processes through empirical studies of designers at work (Schön 1983, Irani 2010). Still others offer meta-analyses of design: elucidating the ways we reimagine the world and ourselves through design practice (Kimble 2011, Rosner and Turner 2015).

development with evangelical appeal. Balsamo (2011) and Suchman (2011) surface the work of cultural reproduction and reflexive intervention as key sites in the development of new technological artifacts and systems.<sup>3</sup> Matt Ratto (2011) asks scholars to use making as a means of conceptual interrogation, surfacing the limits of theory. Beyond the academy, a rich arrange of critical and socially informed design processes furnish new processes of industrial design, technology development and urbanism. Architect and urbanist Ted Cruz, for example, brings the “urgent imagination” of conflict to urban design projects such as affordable housing. Locative media artists use emerging technologies for tracking and mapping as opportunities for examining (and surfacing limitations around) technologies for geographic space.<sup>4</sup> Chris Speed’s Walking through Time [24] mobile app allows people to view historical maps while moving through Edinburgh.

But what sort of agenda does design bring to social science? And what disciplinary approach (and corresponding intellectual tradition) should influence its uptake? In *Designs for an Anthropology for the Contemporary*, American anthropologists George Marcus and Paul Rabinow (2008) recommend the design studio, a pedagogical metaphor for anthropological practice, where, in Tobias Rees’s words, “research, concept-work, and teaching are closely and inseparably intertwined” (Rabinow et al. 2008, p.120). Marcus and Rabinow give new shape to the anthropological project by connecting a notion of design with anthropology’s institutionalized form. By design they refer to the production of the exploratory didactic conditions of collaborative writing or the inclusion and authorization of criticism (Rabinow et al. 2008: 84). They discuss the anthropological method in the terms of design, using this comparison to devise “more organic and balanced” practices. Adopting a design approach in anthropological learning environments, Marcus (2008) suggests, “develop[s] alternative ideas about method in a more comprehensive way than traditional attitudes have permitted.” This anthropological perspective resembles the aforementioned association of design with the crosscutting currents of interdisciplinary knowledge production.

Responding in part to Marcus’ suggestion, British sociologists Cecilia Lury and Nina Wakeford (2014, p.2) gather what they call ‘inventive methods,’ methodological accounts committed to examining the “open-endedness” of social life. The inventive quality for them amounts to honing the relevance and specificity of the research approach. This arrangement frames research as a *happening*, an ongoing and relational program of work entangled with the action underway. Social inquiry thus becomes a means by which researchers might mutually engage social actors. Important here is the notion that method remains in flux through participation: that rather than ‘apply’ methods to problems, we should enable whatever emerges from the research conducted to shift the methods underway. Here we find a more subtle reference to concerns for design integrated with the wide range of responsibilities, relations and contingencies central to any research endeavor; a perspective resonating with the oppositional views described above.

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<sup>3</sup> Seen in hindsight, the development of a media archive served as what Suchman (2011) called a “reflexive probe into the practical materializations” that shape technology development.

<sup>4</sup> See Jen Southern’s audio tour walks, Mark Shepard’s Tactical Sound Garden Toolkit, Christian Nold’s bio and emotion maps, and Chris Speed’s Walking through Time project.

Drawing together design approaches that treat material practices as a way of entangling research questions and outcomes, the cases below highlight a few distinct ways of approaching STS through design. From prototypes to presentations, we conceptualize design processes as more than projects of technological development, even though this is certainly sometimes the case. Rather, we find design projects powerfully shape emerging modes of social and material inquiry. These accounts position the research study as a catalyst for disruption, dialogue and collaboration.

## **Responses**

Responses are hardly new to strains of art practice, or to speculative, adversarial, or critical making/design (Bardzell and Bardzell 2013; DiSalvo 2012; Dunne and Raby 2001; 2013, Ratto 2011). From the Gutai group to Survival Research Labs, a rich history of performance art has reacted to the meanings forged through action and intervention, using alternative technologies to question assumptions about our social worlds and the place of the technical within them (Dunne and Raby 2001; 2013). Our recent Trace project (Rosner, et al. 2015) on geographic information systems (GIS) illustrates such an approach. I use this case to describe how reversing sociotechnical logics shapes people's relation to public space as the application became publically and freely available – both online and as part of its public premier at the city-wide Block Party described above.

The Trace project emerged from a reflection on contemporary technologies for walking. Our design team at the University of Washington convened to explore this technological space and noted a turn toward competition- and goal-oriented techniques. Pedometer++, for example, is a smartphone application that displays bar charts of someone's approximate number of steps (or shakes of a phone). Colors indicate success based on whether the count moves above or below a default threshold. By emphasizing a target number of device shakes or pre-specified destination, these emerging applications oriented walking toward particular concerns for number and end goal, emphasizing geographic precision over "local improvisations," those emergent social practices "out of which new technologies are made" (Suchman 2000, p.139). In other words, the applications became intriguing for their functionalist and individualist approach to the otherwise improvisational and social act of walking.

Based on this initial survey of walking applications, we began imagining how GIS routing could offer situated and partial views of walking that emphasize alternative preferences. What if instead of specifying point-by-point connections through GIS routing, the application framed walking as improvisational? What if instead of attempting to motivate a walk through step counts and tracking, people confronted new social practices through walking? In other words, how might people reflect on existing technologies when presented with the same technology done in different ways?

Trace arose from these questions of difference in GIS routing. The application generates walking routes based on digital sketches people create and annotate without a map. In addition to creating walking paths, Trace enables people to send their paths to others. When someone draws and shares a shape (e.g. circle, star or letter) the application produces stretches of a path that correlate to the vector of that shape. Depending on the

location of that person and how long they wish to walk, the walk will get drawn across different roads and trails.

Together with the Feet First, a local organization focused on the promotion of walking, we took the application to events such as the “Design for Equity” Block Party described at the start of this chapter. Most surprising in these visits was a reoccurring expectation for the application to deliver information. Expecting compatibility with emerging tracking applications such as Nike Fuel or Fitbit, a Boston marathon runner eagerly recording her mileage voiced confusion by the lack of tracking feature. Using Trace during a work trip to New York, she later asked for new sensing capacities beyond step count such as heart rate capture (despite knowing that Trace provided none of these features). Related to this concern for tracking was a sense of inconvenience in slowing down a dog walk or commute. A middle-class office worker put it this way: “I have a short period of time and it’s usually relegated to rudimentary, repetitive exercising processes that are reliable and consistent... [Trace] was much more exploratory and unknown.” Leaving geographic specificity in the hands of an algorithm could also feel strange and unsettling. “It was just so weird,” a woman explained about her walk through suburban sprawl. “It told me to cross the street and then turn around [to the traffic light] and so I came around.” Trace collided with people’s expectations for reliable and specifiable goals.

Soon after the Trace app launched online, a strange meeting with industry developed. A representative from Audi, the luxury car manufacturer, contacted our team to develop a version of the software for what they called an “interactive advertisement” — an online announcement of a new vehicle model that presents the car with an interface mimicking Trace. Once launched online, the representative imagined Audi may eventually choose to build the Trace into the car as a new mode of luxury driving.

Trace thus prompted reflection the ‘partial connections’ produced by mobile applications as they get built into and out of geographic space (Strathern 2004). By presenting contrasts, the building process engendered new feelings of discomfort around technological practices. Unlike ethnographic methods of observation and participation, the responses relied on provocation. Ethnographers take advantage of their own presence in a given setting to surface the concealed, taken-for-granted, and nonverbal activity dwelling within it. As investigators engaged in design interventions, we took novel constraints and possibilities as interjections into lived experience. Our designs elicited reactions to current technical configurations by offering clues for what might alternatives might look like. Our goal was not to satisfy a specific need or to develop design suggestions. Rather, we used Trace to enrich our understanding of people’s relations to walking through GIS.

## **Extensions**

Next we consider extensions, production-oriented endeavors that amplify the value-laden practices of our research subjects. In shifting social circumstance, extensions highlight the dominant logics underlying ongoing technological work, as well as its limitations. To consider this first mode of design inquiry, we turn to feminist hackerspaces in the Pacific Northwest and Northern California where we conducted fieldwork over eighteen months in 2014 and 2015.

Before publishing an academic paper on our fieldwork in the feminist hackerspaces, we sent a draft of our writing to the groups with whom we worked, hoping for any comments or reactions to our writing. Instead, we received an email asking for the rewording of one sentence (conveying a member's background more accurately). We ultimately published the paper with this change, but found ourselves underwhelmed by the modest reply. Their reaction seemed markedly out of character for members of a group who had devoted hours to speaking candidly with us about their frustrations around the treatment of gender in sites of male dominated technology development. Beyond these conversations, they let us sit alongside them at workshops in their spaces and answered questions about their finances and how they interpreted their own positions of power and privilege. We suspected that they had more to say about the work we had been doing, but perhaps we weren't talking in a way that prompted discussion.

Together we created and distributed a zine — a self-published magazine produced with a photocopier. The zine knit together content of a published paper with local histories of feminist print production. The idea for the zine came out of this dissatisfaction with existing models of knowledge transmission — and a chance encounter. While attending a Seattle's Short Run festival — a temporary zine fest for artists to showcase and sell their own work — PhD student Sarah Fox ran into Amy Burek, a feminist hackerspace member. Burek was a scientist who had previously been a PhD student herself and, thus, found the academic style of writing and the format of the conference paper more-or-less familiar. Through this zine fest we also met Emily Alden Foster, an independent illustrator and animator who had recently completed a zine of personal histories and comics around the theme of women in the workplace. She also ran a subscription service that delivered a collection of zines called the Womanzine Delivery Service made by women on a quarterly basis. Over email and video chat, we continued to discuss combining our research findings with the Burek's own experience as a member and the illustrator's watercolor images into a single piece named for the academic paper. After the initial meetings, Burek and Foster worked together for just over a month, combining text and image, before they asked us for final comments and edits. We compensated both artists for their work through a fund that had also covered the observational research.

The zine differed from our published paper. The artists added evocative comic imagery illustrating key ideas. They removed sections of our paper discussing theory and related literature to focus, instead, on our descriptions of the spaces: how they were run, what activities happen within them, and what motivated members to create them. Pushing beyond our published academic paper, they sometimes used generalizing language to describe the women participating in these spaces. Phrases like "Members set the boundaries of who can access their space" appeared in the zine but not in our paper. The artists then attributed the zine to multiple sources, noting that the work was "inspired by and sourced from research originally published in *Hacking Culture, Not Devices: Access and Recognition in Feminist Hackerspaces*." Our names did not otherwise appear on the zine. But should they have? Should the zine have articulated who paid the artists and who curated the content? Whose zine was this anyway? Through attribution, the zine drew attention to multiple authorial voices and the details of their relation.



In electing to put together a zine, we were situating the work in the prior practice of Burek and others who were a part of the spaces we studied. For instance, a cofounder of the San Francisco site had made zines since childhood and the hackerspace regularly hosted workshops for its members to come together to craft zines as a group. Several members also spoke of the commonalities between feminist hackerspaces and the Riot Grrrl movement of the 1990s, which sought to challenge the masculine culture of punk rock through the exchange of craft-based knowledge and the formation of spaces to practice and record music. Zines were an important means of communicating sometimes highly personal stories of abuse and injustice and to document their own histories of the movement.

The zine debuted at the *NYC Feminist Zine Fest* hosted by Barnard College in the winter of 2015. Over the course of the day, visitors regularly inquired about the types of activities that the feminist hackerspaces facilitated and others asked what constituted 'hacking'. "*So are you a hacker?*" one man asked. "*Do you code?*" The visitor only ceded his interrogation when Fox explained she some experience in front-end web development. At an adjacent table, another visitor stopped to look at a zine openly grappling with histories of American slavery; he proceeded to ask similar questions of the producer's technical ability in relation to images she altered in Photoshop.

This instance of distribution highlights another form of "partial connection" among those participating in a site designed to hold up voices and knowledges often unacknowledged. The visitors commented on the definitions of hacking and technology our zine proffered, recalling Ron Eglash's (2002) discussion of masculine geek identity, which could play a gatekeeping role. This limited association with technical ability over other forms of work further separates this geek identity from that of women or people of color (Dunbar-Hester 2013, p.67) while reinforcing the commonality of women's struggles to assert this identity. In that sense, the zine helped expand our questions of partial connection to concerns for both academic and geek identity.

Over the coming months, the zine also helped us build new responsibilities by communicating our concerns in the field. The conversations and ideas that developed at the zine fest continued through the circulation of our zine. After the Barnard festival, the zine found a home in the Barnard zine library and the Philadelphia Public Library, who took copies to add to their collections. We also hosted a PDF version of the zine on our project website, along with an offer to mail a printed copy to interested parties. A few months after this release, the popular feminist writer Ann Friedman recommended the zine in her newsletter, leading to dozens of requests for paper copies and mentions on social media. The zine ultimately re-appeared in our own research circles, helping us gather a conversation on issues of feminist design and knowledge transmissions. Highlighting the contingencies and partialities produced through our original academic writing, our zine asked us to confront the variety of partial connections at play.

## **Interjections**

So far we have seen examples of design projects devised to extend and respond to existing practices and technology products. But what happens when the design project

instead interjects new practices in design engagements already underway? Material *interjections* emerge from ongoing investigation of a field site. Central in this work is the understanding that design practices forge new relationships. To consider how, we turn to our work with a knitting guild in San Francisco, California in 2011 and 2012 – two years of fieldwork that culminated in a design response: a presentation detailing an Android application called Spyn.

I (Rosner) developed Spyn with my collaborator and mentor Kimiko Ryokai<sup>5</sup> (Rosner and Ryokai 2008, 2010) to interweave hand knit fabric (material traces of craft activity) with video, audio, text, and geo-location data collected while knitting (digital traces of craft activity). After annotating the knit artifacts with digital records, the application read the annotations off the knitted fabric using computer vision techniques.

Not long after an article on Spyn appeared in O'Reilly's *Craft* magazine, a member of a local knitting guild contacted me to present the Spyn technology to her guild in the coming year. Aiming to first learn about the group, I joined the guild a few months later. The knitting guild met one evening a month in the recreation room of a local police station on the south end of San Francisco, several miles from the nearest BART train stop. The setting provided access to a quiet, curated space with movable furniture and bright fluorescent lighting. A steady stream of on-duty police officers, mostly male, passed through the space during meetings, contrasting with the mostly female guild.<sup>6</sup> They opened the front door to the cold evening air, sometimes accompanied by detainees.

The organization of the guild highlighted the business of knitting over the social connections forged. Most members had little idea what other members' did outside the guild and some barely knew other members' names. In the first hour of each meeting a president lead the group through agenda items, a secretary took minutes, and each officer delivered updates. In the meeting's second hour, this order began to unravel. A segment called *cheers and challenges* invited stories of mistaken stitches and intricate lace patterns, each relived by passing knit fabrics around the table. This enthusiasm for sharing projects continued as members took turns leading the month's "program." Programs consisted of a presentation on knitting history, a lesson on weaving in ends, or an introduction to Orenburg lace. Annual classes taught by expert knitters augmented the monthly programs by offering daylong events for sharing techniques among professional teachers and members.

Through attending guild meetings, I learned of some resistance to social media. The group had taken more than five years to begin using an online mailing list, and the list remained inactive one year after I joined. A string of more than 25 carbon-copied email addresses accompanied each email to the group. One member without email access preferred correspondence via phone or the post, requiring members to print out important or symbolic mailings such as the annual dues or December holiday photo. After joining the guild, members recruited me to the technology group – a group that never met in person due to hard feelings in years past. In addition to fears that personal information could be

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<sup>5</sup> In this section the 'I' refers to the first author. Rosner attended knitting guild meetings over a period of two years.

<sup>6</sup> Most members were white, college-educated and over the age of 50.

garnered through an online guild presence, some members feared a loss of control over the group identity.

The organization of the guild exposed a key aspect of this resistance to online activity. Concerns for technical skill, length of membership, and degree of commitment remained central for most guild members. Identifying these qualities became a matter of acknowledging social status. Members used 'officer' position like treasurer, secretary, and archivist to solidify these recognitions. However, these relations became difficult to reproduce online. When social networking sites entered the guild a few years before I joined, they were met with some cynicism, a few tears, and lost members. Two new members — one of whom had yet to attend a meeting or meet the guild members — had created a guild Facebook page and Ravelry.com group, respectively. Once members discovered the new page, a few "charter" members demanded that the sites be taken down. The new members never returned to the guild. With each passing week, the possibility of producing an online presence for the guild grew ever more unlikely.

Despite my role in the technology group, I had trouble identifying how this resistance remained, particularly given that many of these same members regularly used information technology while knitting. Some sought out new patterns and techniques via online knitting magazines and YouTube video tutorials. Some frequented Ravelry.com (a social network for knitters) to store their knitting projects and keep tabs on projects. Others engaged in 'knit-alongs' wherein they tackled the same knitting pattern as others across the globe and shared their activity through blogs or other social media. It seemed that fear of identity theft, though likely important, remained an easy explanation for a more complicated and ambiguous relationship to technology culture.

It was not until it was my turn to present a program to the guild that I learned of a more profound purpose for resisting online tools. My presentation introduced vignettes from my research such as images of conductive textiles, examples of "yarn-bombing" (graffiti inspired knitting for outdoor and urban spaces) filled the screen in succession, and stories of using Spyn, the technology I had developed around storytelling. As I introduced this work, my presentation also imparted a view of craft culture resolutely removed from guild life: I referenced the social media associated with knitting activity, which referenced a set of preferences and practices valued by people participating in a youth-oriented 'maker culture' surrounding the guild.

This collision emerged in the monthly programs following my membership, and surfaced most clearly during the course of my presentation. With the lights turned off and the projector on, I tried to make out faces in the audience, noticing a range of responses as I delivered my talk. A longtime member called the work "scary," and later explained, "I was getting anxious and I got a little paranoid ... I was sort of like, why are people doing this? Why are they invading?" The guild president asked, "What is your goal for it? What do you want to have happen?" The guild member without an email account unintentionally began to snore ten minutes into the presentation. Members seemed unsure how new technologies could or should become relevant to their practice. It was in this moment of intervention, seven months into my membership in the guild, that my research turned on its head.

Interactions with members around Spyn helped me make sense of this reaction. I learned that it was not the online tools themselves that prompted bewilderment or anxiety, but the development of a new culture of craft in which they felt unnoticed. Six-year guild member Wanda described this sense during an afternoon trading needlecraft skills in her studio:

I'm becoming invisible. It's kind of hard to explain. Because people don't respond to me the same way that they used to. [...] When you have a young person doing really innovative, interesting things, or something that's really, really complicated, or whatever, that's great. But when you have an older person who's doing really innovative things, or really complicated, it's like: "oh well, of course they're doing that, so what?"

Wanda was not simply referring to a distrust of the digital medium; she noted a perceived undesirability of her age and ability. Such perceptions came early to Wanda. At 35 she began carrying a walking stick after a complicated knee surgery. With a cane in hand, she noticed men no longer, in her words, "ogling" her. After spending her youth rebelling against such treatment, she resented what her walking stick had come to represent. After losing her job in theatrical lighting, a profession she had pursued for over thirty years, Wanda sought to gain income through needlework. She didn't want to put her business or the guild online, but also worried the group would lose 'young' membership without online representation. Though she expressed hostility toward the digital medium, the hostility was less an admission of fear than a reclaiming of territory.

For Wanda and other guild members, the infusion of digital technology and craft techniques propagated by Maker Faires, Indi-craft festivals and myriad online resources contributed to a sense of loss. The longstanding concerns integral to needlecraft practice (Victorian lace techniques or particular histories of Orenburg lace, for example) became overshadowed by concerns for novelty and youth, illustrated by online catch phrases such as "this is not your grandmother's knitting." Digital "enhancements" to the knitting project, such as Spyn, blurred important distinctions between digital and material instantiations of craft. By embracing a history of feminized manual labor, and by selectively framing the visibility of their bodies and practices in relation to a surrounding group of tech-savvy makers, members sought to rigidify otherwise permeable discursive boundaries to maintain their moral claims to craft. An ambivalence to the digital medium prompted moral claims to knitting practice.

By maintaining this boundary in the face of my design response, members call to mind Suchman's (2011) appeal to shift from 'design from nowhere' to 'located accountability.' Rather than eclipse responsibility for technology developments (pointing to 'nowhere'), the presentation sited technology developments in a burgeoning culture of technical 'makers' celebrating the knitting craft. This contrast enabled guild members to articulate distinct ideas of what mattered to their work: a recognition of knitting histories, fine craftsmanship, and material integrity. Engaging with Spyn – a tool oriented toward augmenting social communication around knitting – involved a form of boundary crossing that undermined guild members' personal and collective values. Bringing this project to the guild began to expose these boundaries vis-à-vis claims to craft: how knitters selectively took up and resisted new digitally mediated means of production. Their responses not only revealed

something about the technology itself, it showed us something about the knitting worlds I had entered: that members saw themselves as outsiders to an engineering culture that rendered their work invisible. Despite differences in age, race and knitting ability, the guild members built partial connections through this shared acknowledgement.

### **Design Inquiry as Digital STS**

Our focus on three connected threads follows a rationale similar to one recently described by Lury and Wakeford (2013:2): attending to the ongoing social practices that adapt to and conversely shape our research approaches enables a reflection on the “irreducibly unstable relations between elements and parts, inclusion and belonging, sensing, knowing and doing.” Responses acknowledged an emerging technological turn toward step counts to imagine alternative framings on GIS walking. This work explored the form GIS algorithms take when they unfold through social connections rather than pre-specified destinations. Extensions brought us from participant observation to collaboration within feminist hackerspaces around the production of a zine. In these sites, we sought definitions of feminist design by collectively unpacking technology conventions. Lastly, interjections took us from a process of participant observation to a presentation within the guild. The presentation served to catalyze reactions and conversations on guild members’ concerns for the entanglement of computation and craft.

Together these design trajectories describe a set of unique entry points for conducting studies of technology cultures. However, their distinctions remain supple. For example, the workshops we held at two feminist hackerspaces could have invited *responses* to a feminist ideal wrapped up in the conditions of possibility that practices of technology development enable. In earlier work, engagement with the Ssyn application enabled us to *extend* existing modes of social media use among people posting on knitting websites like Ravelry.com (Rosner & Ryokai 2008; 2009; 2010). These approaches overlap and collide, often relying on one another. In this sense, the set of practices offered here represents only a subset of perspectives on design inquiry in STS. We do not chart this vast landscape or cohere a single or absolute vision. Each of these framings —responses, extensions, interjections — present neither stable nor separate forms of study. Rather, by conceptualizing a set of related methods, we offer a language for characterizing the myriad and overlapping modes of design research arising in STS.

In some ways the above cases demonstrate a meeting of impoverished social science and flat-footed design. At first pass, our cases seem to overlook the distinct histories of manufacturing and organizational labor on which these design projects depend. They equally miss the impacts associated with design products brought to market or the normative categories they inhabit (for example, designations of “successful” design). Through this confluence of fieldwork and design we instead unlock a set of material practices predicated on the understanding of what technology does. This doing of technical practice in different ways enables research activities to highlight the dynamic performance of various social relations in programs of insight and responsibility. In this making and telling of human experience we recognize the ethical and analytical character of design underway.

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