

Hacking Culture, Not Devices: Access and Recognition in Feminist Hackerspaces

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ABSTRACT

This paper examines the motivations, activities, and ideals of people organizing feminist hackerspaces: collaborative workspaces developed to support women's creative and professional pursuits. Drawing on interviews, participant observation and archival data collected across the Pacific Northwest over nine months, we show how members of these spaces use small-scale collaborative design and acts of making to work out their place in society in ways that contest widely accepted understandings of hacking, technology, and collaboration. In designing how the space should look, feel, and run, members reframe activities seldom associated with technical work (e.g., weaving, identity workshops) as forms of hacking. In so doing, they shift concerns for women in technology from questions of access (who is included) to questions of recognition (who is visible) while grappling with productive ambiguities in between. We describe lessons these tensions present for examining women's relations with technology in CSCW.

Author Keywords

Hacking, making, craft, hackerspaces, feminism, STS.

ACM Classification Keywords

K.4.0. Computers in Society: general.

INTRODUCTION

Over the last ten years, makerspaces and hackerspaces have cropped up far and wide, from San Francisco to Abu Dhabi. These practices have become of increasing concern to the field of computer-supported cooperative work (CSCW) as it reaches beyond design implications to policy and industrial change. CSCW and human-computer interaction research following these trends explores hacking as grassroots entrepreneurial and technological innovation [4,25,26,34,36].

In this paper, we focus on emerging forms of hacking in

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feminist hackerspaces — workspaces that support the creative and professional pursuits of women. Feminist hackerspaces developed in 2012, most prominently in the Pacific Northwestern United States, to make room for different values, goals and practices. We examine the feminist ideals that develop in these spaces as both discursive and material phenomena that shed new light on what counts as hacking, technology and collaboration. More specifically, by tracing the often-explicit interweaving of hacking things with hacking the self, we show how feminist hackerspaces reorient our concern for women in technology from ideas of access to an ongoing working through of definitions, acknowledging the breadth of technical work that women already do. Hacking thus becomes a technological imaginary, a set of deeply held ideas and norms subject to failures and partial readings that shape the work of technology cultures.

To arrive at this argument, we draw on interview data and ethnographic fieldwork conducted in women-oriented hackerspaces over nine months as well as research in science and technology studies (STS) and gender studies that seeks to challenge perceptions of technology and innovation as stable or fixed categories [44]. In focusing on feminist forms of collaborative work, this paper follows a renewed interest in the role feminist epistemologies and methods might play in research on social and collaborative systems, a trend most evident in recent conversations within the CSCW community [13,22]. In particular, we adopt a reflexive position in which we examine the workings of not only our participants but also ourselves. Rather than emphasize a feminist research agenda, however, we sought to engage those who have already adopted and adapted feminism for their purposes: to build and maintain community, to articulate difference and subvert oppression, and to catalyze (and help fulfill) personal and professional goals. In particular, we pose the following questions: (1) What does it mean to gain access to these spaces? What forms of participation and collective practice emerge? (2) What makes these spaces sites of hacking? What kinds of work and tools do these spaces encourage or make possible? (3) What makes these spaces 'feminist'? How is feminism enacted?

In addressing these questions, we offer three contributions to CSCW. First, we extend CSCW's discussions of feminist theory and Johanna Sefyrin's argument, in particular, that "to find women who participate in the design of IT, [...we might] analyze the practices behind the professional catego-

ries that are involved in IT design” [40:708]. Rather than professional IT design, we examine forms of hobbyist innovation and technology development that remain variously overlooked, such as sensibilities of craft and concerns for identity work. Second, we contribute a new perspective on emerging do-it-yourself collaborative work practices that surfaces some of the tensions and ambiguities around inclusivity and control, particularly concerning women’s place in those activities. Lastly, by revealing the frictions within, we show how hacking becomes a site for working out women’s relations with technology in productive ways, ultimately enabling us to reimagine women’s engagements with collaborative systems and how those relations might be done differently.

Related Work

Before we discuss how feminist approaches have informed CSCW scholarship, we wish to briefly consider the historical forces at work behind the scenes. According to historian Ruth Oldenziel, long before hackerspaces and technology startups, Victorian era women authors used the literary genre to develop stories around engineering, a typically male genre: “deliberately choosing the engineer as the protagonist for her novel, she chose to display her competence in a male genre for the purpose of casting it aside, thereby signaling a new relationship with her readers” [32:140]. American Progressive era women, historian Steven Gelber [14] explains, similarly took pride in being able to perform a ‘man’s job’ in home improvement [14:99], undermining do-it-yourself manuals’ portrayals of women as generally unwilling to use heavy tools. Feminists of this period in Britain and the United States welcomed machines that carried out strenuous domestic work as part of a “grand domestic revolution,” according to urban historian Dolores Hayden [20]. These women actively debated the influence of technology, identifying economic exploitation by men as the root of their inequality.

More recently, feminist designers and critics have pointed to important disconnects between the stereotypes circulated about women and the changing ways women see themselves. Members of the 1980s feminist architectural collective Matrix, for example, have critiqued the ‘idealized’ pattern of women’s place in suburban homes in the United Kingdom, correlating the isolation of domestic life with women’s subordinate position in society [28]. A decade later, the Riot Grrrl movement, spearheaded by members of the punk scene in Olympia, Washington and Washington D.C., challenged the masculine culture of punk rock through the exchange of craft-based knowledge and the formation of spaces to practice and record music. They broadcast their motto ‘Revolution Girl Style Now’ through a series of *zines*, handmade publications with limited distribution [51]. Today, several of the feminist hackerspace members we will describe similarly foreground craft-based knowledge and have contributed to the publication of *Mod-View Culture*, an online publication with an accompany-

ing print quarterly, tackling topics such as ‘sex and sexuality’ and surveillance.

Though the emergence of feminist hackerspaces is fairly recent, the driving forces behind them are not new. Next we consider how these legacies of opposition reemerge within recent work within (and just outside) CSCW on hobbyist and small-scale creative activities, and discuss their recent uptake within design and engineering communities.

Hacking, Craft and Collaborative Work

Over the last decade, research in CSCW and human-computer interaction (HCI) has focused new attention on cultures of hacking, making, crafting and do-it-yourself (DIY) practice. This work has positioned hacking as a necessary facet of livelihood work [24], a pleasurable mode of technical engagement [19,37,41], a ‘grassroots’ model for innovation and entrepreneurship [26,47], and a form of resistance to mainstream culture [4,25,47]. This last strand of research has emphasized the social and cultural transformations hacking can bring about, troubling definitions of access, openness and transparency [8:514].

Put into practice, this perspective has prompted Buechley and colleagues to develop hardware and software tool kits to help people, especially girls, develop engineering skills through craft activities such as sewing [7]. The hackademia project by Kolko and colleagues similarly provides pedagogical infrastructure for supporting ‘non-experts’ in gaining technical literacy [25]. Through hacking, technologies may make space for new values and gender dynamics [37].

However, highlighting limitations to these social transformations, Dawn Nafus examines open source software developers to suggest a “broader problem of socio-technical construction, where both the material aspects of computing and the social identities that people create for themselves [...] are cultures made by and for men” [31:671]. Others have traced women’s roles in hobbyist computing cultures, showing how hacking affords opportunities to reaffirm masculine imagery through ‘healthy rebellion’ associated with electronics disassembly [36, 38]. As we will see, the spaces we visited challenged masculine claims to computing by broadening categories of socio-technical production.

Feminism and CSCW

CSCW research so far has used feminist approaches and frameworks to make sense of new collaborative social systems, examining the role of gender in digitally-mediated peer production [13], investigating differences in attitude and engagement among men and women in online reviewing communities [20], and exploring the use of reflexivity as a feminist approach to studying and supporting the organization of social movements [10].

Resurfacing some of these trends, Bardzell and Bardzell have outlined information technology research methods that rely on feminist epistemologies that reflect “a core value of feminism: critiquing and resisting the status quo” [5:675]. Most recently, a 2013 CSCW workshop on feminist ap-

proaches to social media research [22] sought to help researchers learn from each other, reflect on their work through questions of gender representation and inclusion, and explore how a feminist agenda might refigure definitions and research programs in CSCW. In general, these activities emphasize the need for studies of CSCW to investigate how forms of cultural production reaffirm or challenge the oppression of women through economic, political, social, and psychological means.

Our work directly builds on these efforts by examining the emergence of self-defined feminist hackers and how they have used the term *feminism* in defining their goals, collective activities, and to some extent the things they create. In doing so, we also point to opportunities for developing a design discourse within CSCW that not only helps us imagine fresh roles for design within social systems research, but also integrates contemporary feminist approaches currently underexplored by the field. Rommes and colleagues contend that IT development has benefited little from feminist studies and vice versa, concluding, “*it is still an open question how feminist theory and gender analysis of ICTs translate into a ‘feminist’ design of computational artifacts*” [35:656]. It is this question we seek to explore by investigating the social organization of feminist hackerspaces.

Just outside CSCW, a different and somewhat more radical body of feminist scholarship has engaged with design and technology development through the lens of new materialism [2,23,46] often proceeding from the field of Science and Technology Studies. This approach has invited a critique of conventional technology and gender studies in which scholars treat technology as ‘open to interpretation’ but gender as stable [28]. Some of this thinking arises from ‘deconstructive feminist theory’ which, according to Doris Allhutter, “disavows ‘femininity’ and ‘masculinity’ as ontologically coherent identities” [1:685]. Using a form of ‘deconstructive’ memory work wherein people recognize and describe memories using clichéd language, Allhutter calls for direct intervention into the ways software developers forge their social relations. In doing so, she seeks to draw attention to normative sense-making strategies involved in memory work. By reflecting on their language, developers may make decisions that reflect their recognition of a-priori assumptions.

Despite the promise of such interventions, other scholars identify important hurdles to adopting feminist approaches in IT development. For Suchman [44], for example, the categories of “designer” and “user” obscure the complexities and contingencies of the social life they describe. Johanna Sefyrin [40] builds on this argument by exploring the practices behind our accounts of IT development, suggesting that women get systematically excluded from these accounts. By following women participating in an IT design project in a Swedish government agency, Sefyrin shows how the substantive contributions women make go unacknowledged: “*the question of whether women can be*

considered insiders or outsiders of IT design also has to do with how ‘IT design’ is defined” [40:709].

It is how this definitional work informs our analysis of collaborative systems that we consider next. Just as Allhutter, Sefyrin, and others use their investigations of the mutual-construction of gender and technology as an intervention into social studies of IT, we offer our analysis of feminist hackerspaces as interventions into CSCW design and development methods. As we will describe, our work as interviewers, observers, and participants enabled us to better understand and also interject new questions into these worlds, fostering reflection among our research subjects and ourselves.

EXAMINING FEMINIST HACKERSPACES

Since their inception in 2012, women-oriented hackerspaces have offered local residents a place to gather, share ideas, learn creative techniques, and grow professional partnerships in what some term an “emerging DIY culture” [30]. According to our interviewees, the Berkeley-based Mothership Hackermoms — a community workshop dedicated to the needs of “mothers of all genders” [30] — were first to introduce such projects to the ‘hacker’ scene. Their funding campaign on kickstarter.com and a panel at the San Jose DIY festival *Maker Faire* sparked a flurry of interest, particularly among participants at women-oriented IT conferences like AdaCamp and women-in-tech mailing lists. Soon after Hackermoms opened its doors, organizers of the Seattle Attic launched what they called a “feminist hackerspace,” a material response to the male-dominated technology community of which many of the members were professionally affiliated. Inspired by subsequent conversations at the *2013 AdaCamp* in San Francisco, participants began feminist hackerspaces later that year in Portland (Flux) and San Francisco (Double Union). Organizers of the sites remain connected through what a Seattle Attic member called an “informal network.” They maintain a Google Group featuring continued threads of conversation about their respective hackerspaces and shared resources like example planning documents. They are also connected to other non-feminist spaces by personal relationships like roommates (in the case of Double Union and Noisebridge), or marital partners (who were members of Mothership Hackermoms and Ace Monster Toys respectively).

From their inception, the Seattle Attic and Portland Flux have allowed members of any gender (roughly 12 of 18 identify as female at the Attic; 2 of 13 in Flux) while San Francisco Double Union has not allowed members who identify as male. Upstart costs for each of the sites was provided largely by one or at most core set of a few organizing members. Continued funding was collected from membership fees and, in the cases of Seattle Attic and Double Union, successful crowdfunding campaigns.

In our conversations with leaders of these spaces, we learned that their original motivations focused on concerns

for safety and shared values, often materialized in the physical design of the space. One organizer explained:

As a woman in technology, it's like, I'm already part of a like a 10, 20 percent group so it doesn't really take a lot to turn me off. So I think like I'm just more sensitive to like things like the space sucking and being dark and gloomy.

Becoming “more sensitive” to the design of the space seemed to come, in part, from feeling marginal to technology cultures. Other members noted discomfort and even vulnerability in their interactions within existing hackerspaces, often declining to share personal experiences in favor of recounting the experiences of others:

I would almost rather share the experiences that I've heard from other women in town [... A woman] was working on something and this kid next to her was like bragging to her about how he had gotten a woman online to show him her breasts by threatening to hurt a kid. And she was like "What is going on here? Why are you telling me this?" And she looked at the guy who runs the space and pays the rent here and was like "Are you going to do anything about this?" And then, like, he didn't.

Accounts like this one point to the moral character of such retellings, asking us to consider how third-person reports implicate others (a “kid,” a “guy”) in the accomplishment of value-laden practices such as sexual harassment. By describing the lone woman in the space and the man’s detached disposition (in a place of authority but doing nothing to resolve the matter), this member suggests a kind of moral imperative to reveal rather than conceal unethical practices.

Similar stories of harassment circulated widely in the spaces we visited, reinforcing members’ desire for both awareness and acknowledgement of oppression. They became implicative of the kinds of reflexive practices not normally considered integral to high-tech environments within large corporations or academic institutions. Yet not all members made investments in learning and practicing technology development. While most Seattle Attic members worked within information technology (IT) industries, several of these professions fell under customer service. In Portland’s Flux, seven of twelve members identified as professional programmers. As our work unfolded, we found these affiliations with IT industry shaped how members participated in (and pushed back on) hacking and engineering.

Methods

To investigate our questions we took a qualitative, ethnographic approach. In October of 2012, the third author began ethnographic interviews with Mothership Hackermoms, a women-organized site dedicated to helping mothers feel more fulfilled by their creative and professional pursuits. She observed members’ practices in their own environments and documented them through a combination of photos and field notes from December 2012 to July 2013. All

three authors subsequently followed up this fieldwork with ethnographic interviews conducted between January 2013 and February 2014 with 13 maker and hackerspace members who engaged in processes of redefining the role of marginalized groups, primarily women, in technology production and hacking. This included computer programmers, fine artists, and authors as well as leaders of four feminist and women-operated hackerspaces and a male member of a ‘traditional’ hackerspace who began a feminist book club. The third author additionally interviewed ten organizers of related technology development endeavors such as Survival Research Labs and the Flaming Lotus Girls in Northern California. Lastly, we conducted research in the members’ online archives and in individual participants’ collections of artifacts and writings.

We identified interviewees based on recommendations from close contacts and other hackerspace members, our prior knowledge of their work, and public listings of their activities in hackerspaces or online. Interviews followed a semi-structured format organized around questions of identity, goals, and practices, the members’ experiences in the spaces and their motivations for joining. Most interviews lasted between one and two hours, and we conducted all but one interview in person. Whenever possible, we combined interviews with hackerspace visits and observations of events and workshops in and around three feminist hackerspaces: Double Union in San Francisco, CA, Flux in Portland, OR, and Seattle Attic Community Workshop in Seattle, WA. To the best of our knowledge, these collectives represent the first of five in the United States to call their spaces “feminist hackerspaces.”

Our approach draws on interpretivist perspectives in which researchers aim to translate rather than transcribe social phenomena. Instead of seeking an objective, transparent view of these settings, we used our own subjective experiences — often closely tied to the subjects we studied — to generate *intersubjective* knowledge. In particular, we considered how our status as upper-middle class researchers presiding as faculty or pursuing postgraduate education at a public institution in the United States might influence our accounts. Additionally, each of us identifies as female and is similar in age (24-34) and race (white and Asian) to the members we observed in each of the spaces. We have also worked professionally in the technology industry and identify in some way as feminist. While studying members’ ‘social justification of belief’ [26], we considered the extent to which we resembled our subjects in background and ideology.

In conducting our analysis, we sought to deepen discussions of feminist approaches in CSCW by reflecting on the activities of both our research subjects and ourselves in line with interpretivist and inductive approaches [26]. This entailed a close reading of our data while ‘dwelling in’ new materialist scholarship encouraging forms of reflexive intervention within design and engineering cultures [2,23,46]. The re-

search team met frequently to iteratively code our field notes, interview transcripts, and archival data and identify emergent themes. Alongside weekly meetings, we met regularly with a member of the social science faculty at our home institution to discuss our subjective perceptions and improve the accuracy of our interpretations. Early rounds of coding guided subsequent data collection, such as a tighter focus on issues of access and recognition that emerged as key themes in our fieldwork. When disagreements arose, such as the scope of the term ‘access’—which ranged in understandings from the physical means of entry into the spaces to membership application processes—we revisited our first-hand reflections on the organizational setting and external theories to interrogate differences of interpretation. The following sections draw out aspects of our fieldwork and interviews directly related to the questions of participation, hacking, and feminism explored in this analysis.

What does it mean to gain access to these spaces?

To begin thinking about the forms of access and participation that emerge in these spaces, we wish to visit an excerpt from the field notes where we entered Seattle Attic for the first time.

I found the main entrance to the building closed and only accessible through a side door protected by a callbox. When scrolling through the names in the callbox I found half of the space’s title along with the first name of its original organizer. I pushed the button to request entry and was sent to a computer generated automated message that triggered the system to buzz me in. I made a few turns and found my way to a set of two traction elevators, loud and slow. I could see the gears and pulleys working. When I arrived on the correct floor I found the space by following the only light. I knocked lightly on the glass of the door and I was told to come in.

Even from these early interactions we observe some of the features of the space that hint at wider concerns for who may engage with and within it. To begin, the partially-visible name on the callbox label and concealed entrance suggest an intentional obscuring of the hackerspace project. In an interview, the founder described the name of the space, Seattle Attic Community Workshop, as a “*completely neutral like new term that I just pulled it off [sic] my ass.*” She made no direct reference to a way of working or a community of practice and, instead, located her thinking in Marxist scholarship calling for a “non-repressive inclusion of all the groups marginalized by a bourgeois society” [15]. For her, this meant rethinking how people who may not currently consider themselves hackers and makers might build a hackerspace — “*both the name of the Attic and also the imagery and design,*” she explained. Another member pointed out that the Seattle Attic remained, as far as she knew, the only wheelchair accessible hackerspace in Seattle “*and that was not accidental.*” Participation in the space

meant not only dissolving certain barriers to entry, but also actively extending who gets access inside.

The location of the hackerspace itself enabled another form of participation, one that emphasized members’ interests in controlling access. Like the pulleys that revealed the inner workings of the elevator, the door of the hackerspace remained visible to a searching eye but otherwise hidden from the street. This tension between visibility and refuge unfolded in other spaces we visited. Two authors got lost during fieldwork in a less-trafficked area of Oakland, discovering that their mobile mapping application incorrectly positioned the space. They ultimately called the hackerspace member they planned to meet, who subsequently drove them to her space. We later learned that she and other organizers of the space purposefully chose not to locate their hackerspace adjacent to San Francisco serving transit in order to better serve their immediate, local community (instead of interested outsiders like us). This experience of struggling to find our way and relying on a hackerspace member for guidance prompted us to reflect our variable positions in the spaces and communities we were visiting. To some we were guest researchers and workshop facilitators, but to others we were conspicuous outsiders and perhaps even interlopers. Whatever the case, we depended on the organizers and members to let us in and sometimes even pick us up down the street.

A feminist hackerspace in San Francisco similarly chooses not to disclose their address online and instructed us not to share its exact location in our reports. Only visitors already familiar with the space or determined to find it might make their way inside. At the Attic, the age of the elevator and quality of light in the space prevented us from catching an immediate glimpse. Ambiguity and obscurity, in this way, became modes of selective recognition, a notion that contrasts with declarations of openness touted by members of many other community organizations and hackerspaces [4,26]. Rather than open to all, the space became available to people who knew how and where to look. This method of coming into contact with members prefigures an uncertainty around inclusion in the hackerspace, as demonstrated by codes of conduct.

Moral Accountability

Organizers developed codes of conduct to provide institutional safeguards against harassment and opportunities for those marginalized in high-tech contexts to feel supported. One founder described her willingness to apply such codes:

If it were to turn out that key people in our organization were acting abusively then [...] we would be aware of the defensive dynamic that often happens and try to divert that.

By enforcing codes of conduct, this member hoped to support open conversation about shared values and topics such as gender, identity, inequality, and inclusion while ‘diverting’ other kinds of social dynamics. As Sophie Toupin, a

feminist scholar and member of a feminist hackerspace in Montreal recently wrote, “*When feminist and anti-oppression politics are not explicitly part of the ethos of a space whether virtual or physical, the burden of education will often be placed upon the people who are living these oppressions*” [48]. Without these codes, members faced having to explain their viewpoints again and again, as opposed to doing the work that they came to the space to do. One member spoke about her first impression upon reading her feminist hackerspace’s anti-harassment policy:

“[E]ven before I knew anyone here, [...] I didn’t need to be anything other than myself because I totally cleared everything on the list.

‘Clearing’ the list meant getting through an initial filter that allowed members show up to the space feeling confident they would be treated ethically. Members of each space described vetting potential new members through nomination, voting and, in some cases, in person meetings during an open house. This process raised concerns for whether the group might become a clique, one member noted. Leigh, a founding member of Seattle Attic described codes developing in response to prior experiences with what she called “shit-testing.” When asked to elaborate, she explained:

I think of [shit testing] like in security, there’s this idea of failing open versus failing close. If there’s a failure condition, do you let anything through or do you stop letting anything through? Shit testing is like failing closed. It’s like making people justify their presence, like are they really hacking or whatever all of these different ways that people sort of police who can and can’t be in the space. Whereas like requiring the people operate from a fundamental position of respect is like failing open.

Reflecting her technical background, Leigh drew parallels between her space’s membership policy and security code. As an example of ‘failing closed,’ shit-testing serves as a policing mechanism that does not make its rules apparent. ‘Failing open,’ on the other hand, implies acting respectfully toward other members, regardless of their technical skill, with the expectation that they have agreed to the same fundamental rules and possess similar values — whether or not they program or align with a specific definition of hacking. In addition to illustrating differences in the ways members manage the space, the metaphor also reinforces this member’s own background in internet security, simultaneously legitimating her right to use hackerspace discourse and opening it up to critique. Just as the ambiguous signage, the locked, somewhat obscured entrance and the computer-generated message point to a means of selectively limiting physical access to the space, the process of engaging with members and becoming a member reveal an equally important emphasis on controlling participation. In this way, the rights to admission that get materialized by the space get set up against a conceptual framework of openness and sharing to which the members appeal (exemplified, as we

will soon see, by tools such as the ‘documentation station’). Enabling participation, therefore, become less about admissibility and access than moral accountability.

Collective Practice as Companionship

Before turning to specific modes of hacking, we wish to highlight one last aspect of members’ participation: what one member described as being “companionable.” By this she meant a sense of cohesion enhanced by diverging activities: “*working on typing, and then have someone over there reading in the library, and then flipping through books, and another person -- two more people on the couch having a conversation.*” The language of companionship came to define and support the development of feelings of confidence. For example, when one space needed new tables, a member with expertise held a ‘table-building workshop,’ showing people how to assemble durable and aesthetic tables, enabling collective investment in the space, and strengthening her belief in her own abilities as a maker. The experience left her feeling “*less of a member and more of a partner.*” Working alongside one another as companions meant collectively struggling with questions of independence and professionalization. Another member referred to this as “*computing together,*” or “*having a space where you can come into your own but also watch other people learn and grow.*” We witnessed this kind of cooperation as a powerful yet silent alliance between members, foreshadowing the hacking practices that develop across these sites.

What makes these spaces sites of hacking?

Hacking, as documented in prior scholarship [4,8], implies multiple sensibilities, from rebellion to technical prowess, to ‘dilettantism,’ engaging in engineering activities as an amateur rather than professional. Within the three feminist hackerspaces we studied, notably different definitional work came into view, most clearly through the tools members put to use. In this section, we uncover hacking as forms of crafting and identity work, noting the contested nature of these transformations. We then describe difficulties members experienced in assuming a hacker identity and the ideological shifts they hope to bring about.

Hacking as Crafting

On the face of it, many tools within these sites seem at home in a conventional hackerspace. We observed resources for hardware hacking such as soldering irons, laptops, and what one member called a “documentation station,” a tripod-mounted webcam with a microscope and light positioned over an electronics workbench for digitally capturing and sharing video of microelectronics tinkering. As in other recent accounts [4], analogue tools sat next to these devices. For instance, during workshops in Seattle Attic we saw knitting and crocheting tools, a variety of looms, button making supplies, a 19th century, industrial sewing machine, and associated restoration materials. Such juxtapositions to call into question the kinds of activity identified as ‘technology’ in line with common definitions of do-it-yourself culture that contest mainstream technology development (e.g., [4,26,36]).

In addition to challenging technology conventions, we found the notion of hacking as dabbling or tinkering trumped by the seriousness and care with which members approached their non-digital work. At one fiber-arts workshop, for example, an organizer passed around samples of her materials, some in their raw form and others that she had spun by hand. She explained the differences between synthetic and protein fibers, the strengths of these fibers before and after weaving, and what happens to them when met with water. Her close study of the material make up recalled her doctoral training in a chemistry lab. This merging of hackerspace activities with careful craftwork suggests an intentional entanglement of hacking and practices traditionally associated with women.

Hacking and the Aesthetics of Domesticity

Stepping back from organized activities, we find the layout of these spaces offers another picture of hacking within these worlds. During off-hours, members tended to work alongside one another on couches or other comfortable furniture under soft lighting. The incorporation of domestic furniture and an aesthetic of coziness — the close proximity of chairs and tables, accent colors like orange on the Attic’s trim or teal in Portland’s tables, small areas for refreshments (tea making, in particular) — distinguished the spaces from their office-building neighbors.

During our conversations, a number of members expressed an interest in creating spaces with clean and ‘open’ features. This can be seen with the removal of an office door bisecting the Seattle Attic. In a similar adaption, several members of the San Francisco space felt the roof of the rented office space felt too low. In response, they took out the ceiling tiles, revealing natural light through rooftop windows, and installed a set of paper lanterns. They described this as a cheap solution to opening up the space as well as creating more natural, soft lighting as opposed to the artificial, fluorescent lighting that was originally in the space. Another member noted, “...we tried to make this as physically inviting as possible. This is also a cleaner space than a lot of hackerspaces [...] you see something dirty, you clean it up...clutter can also be an accessibility thing.” Members from San Francisco Double Union also indicated a desire for organization in the space, noting that “developing more labels ...will help.” In this sense, members began to hack not only their existing spaces, but also a dirty and chaotic garage aesthetic long associated with masculine do-it-yourself culture [14].

The Ambiguity of Hacker-Identity

When it came to defining hacking, several members recalled the film *Hackers* and its mid-1990s portrayal of the young white male breaking into computers and using them for unintended purposes. Others characterized the activity in contradictory or uncertain terms. For example, one organizer who initially described *hacker* as a “compliment,” noting, “It’ll be like calling yourself a genius,” later explained:

I think the term can kind of really be pretentious, you’re just working on your iOS app all day, like your hackerspace, [...] but then that comes back into this policing of what is hacking. So, I have like mixed feels about that.

In this way, hacking entailed certain ambiguities, critiqued for its self-importance or its encoding of individualism and technological utopianism (as in [41]), and prompting members to wrestle with their discomfort with such critiques.

“Intersectional feminist” hackerspace founder Jen Mai Wu felt that the terms *hacker* and *maker* lacked representation for people of color and low-income residents, those unable to ‘take advantage’ of the maker movement. She explained:

[Hacking is] like a rebranding of stuff that has been going on for a long time [...] You make your jams, whatever. You grow your own food. Now people are doing that, and they’re kind of like boutique, expensive stuff. [...] I noticed that a lot of the people who were benefiting from the maker movement who kind of were able to liberate themselves from the job that they didn’t like and were able to do something like take a hobby and turn it into something they really loved.

Growing up canning as part of a routine activity, she found projects associated with the so-called maker movement oddly familiar. The fact that they celebrated such domestic labor as a “boutique” leisure experience further highlighted their privilege. This privilege entailed not only an ability to learn new skills, but also a capacity to frame such learnings as sources of empowerment, opposition to the conventional “job.” Resisting mainstream culture requires an advantaged position in society, as Coleman explains: “those geeks and hackers who channel their labor politically represent one type of privileged actor” [8:515]. This perspective — brought into the territory of domestic work — begins to further undo and destabilize the cultural project of hacking and making. Pointing to the maker movement as a catch all for the counterculture invites new contestations of hacking.

Hacking as Identity Work

Alongside such ambiguities, we observed practices of looking inward — a kind of hacking of the self — become valued but often misunderstood forms of innovation within these spaces. We spoke with an organizer who explained how she decided to leave her graduate studies after observing sexism, racism, and emotionally abusive management techniques from her male supervisors. As female academics working primarily in male dominated fields of technology design and computer science, we were able to relate to her experiences with a fairly high degree familiarity, even to the extent that we knew some of the same researchers. In many ways though our differences, namely her departure from the academy versus our choosing to stay, became the more important aspect of our conversations. Referring to her choice of leaving her program as “leaning out,” she contrasts these experiences with her leadership experience in the feminist hackerspace:

I never put myself down as a leader, what have you, but I'm getting compliments on how I'm running the meetings and on my leadership - it's amazing. It's like, where did that come from?

While building confidence in these new skills, this member wrestled with redefining herself as a leader. She reflected on this issue in a daylong, women-only hackerspaces workshop dealing with ‘impostor syndrome,’ what one member described as “the inability to own one’s accomplishments.”

Before we discuss this workshop in more detail below, we wish to point out how this attention to self-definition resurfaced in additional workshops catered to the process of building and maintaining one’s sense of purpose and role in society. These tendencies to examine the self as a site of hacking extended to events at other women-organized spaces, including “identity workshops” and a weekly meeting called “Failure Club.” For participants in Failure Club, failure meant not playing by the rules and getting yourself at least part of the way toward your goal. One woman who sought to write a memoir without prior writing experience finished one chapter by the end of failure club — a massive feat that involved challenging bouts with childcare. “The only true failure is not showing up,” the club founder explained. Breakdown implied innovation; productive changes in one’s life plan.

Importantly, these breakdowns surfaced in our own fieldwork experiences as well, particularly as we sought to relate to issues of motherhood, race and socioeconomic privilege. As middle-class women belonging to different racial and ethnic groups, we found such interactions unsettle our own roles as outsiders, participants, colleagues, and friends. During our analyses, for example, one author became a mother, creating recurring moments for reflection on dissolving definitions of self and new opportunities for analysis. Taking a cue from Jackson’s recent writing on breakdown and repair [24], we find our own standing within these spaces constructed different moments for a productive reimagining of conventional forms of innovation. As we look to the role of feminism in these spaces, we more closely examine this attention to fracture and failure.

What makes these spaces feminist?

To understand how members describe these spaces as feminist, we first look to their strategies for differentiating various strands of feminist thought, particularly the feminist ideas promoted within the hackerspace and those circulated by popular accounts of IT development. In our informal conversations, several members expressed overt criticism of popular views on feminism, especially those of Facebook COO Sheryl Sandberg, author of the best selling autobiography *Lean In* [39]. At the time of writing, for example, we learned of a campaign underway at Double Union to edit, correct, and provide inline commentary on a copy of Sandberg’s book that had been facetiously donated by a fellow women-centered technology organization. During multiple

meetings, we observed members denounce Sandberg’s message that women should take on stronger leadership roles as putting the onus on women to move toward gender equity. Such discussion extended to other women-oriented sites. For instance, after concluding our interview with Oakland LOLSpace member and organizer, Jen-Mai Wu, she asked what the members of the feminist hackerspaces thought of *Lean In*. When the first author told her that many of them expressed criticisms, she nodded, offered a slight smile, and said, “Good.” Attitudes toward the book became a gauge by which people could assess each other.

However, differentiating Sandberg’s feminist ideas from those of the hackerspace became more difficult. At a day-long ‘impostor syndrome’ workshop hosted at the Seattle Attic, we found that much of the conversation focused on popular accounts of the “syndrome,” also cited in Sandberg’s book. For instance, the facilitators discussed a quantitative study measuring how individuals interpret their “locus of control” that found women more often felt that they did not have power over their circumstances, a dilemma Sandberg seeks to unseat. The facilitators also led an exercise based on the work of Amy Cuddy wherein participants assumed a series of “power poses” for several minutes. This portion of the workshop focused on recognizing and combating feelings of inadequacy, mostly in professional settings, in much the same way that Sandberg discusses.

Where we began to see differences between the feminist messages in *Lean In* and those of the hackerspace were in subsequent conversations highlighting structural barriers women confronted in a more adversarial or even slightly fraudulent manner. One approach by Pyladies of Portland, a women-only Python meetup, involved first teaching novice members to become fluent with the core competencies of git, an open source version control system. The idea, the workshop facilitator explained, was that when these women code in public they appear highly skilled to those around, bypassing some of the potential “shit-testing” they might normally endure. Similarly, during the workshop, one organizer spoke of Adria Richards, a technology consultant who identified technological work as being her “ticket out of poverty.” According to the organizer, Richards’ stated tactic for dealing with people who were trying to test her knowledge was to “steamroll them.” Stemming from this conversation, the organizer told the story of her recent highly publicized firing from a development job. She recounted that while at a technology conference Richards overheard lewd comments about “big dongles” from male conference goers. Richards’ response was to publicly shame them by posting their photos on Twitter. Richards was subsequently fired from her job because her company found the violation of privacy more offensive than the original comments.

Through telling these stories, members distanced themselves from a rhetoric of participation implicit in *Lean In* and other popular feminist accounts. Rather than expecting that women should be able to ‘sit at the table’ with men,

these hackerspace members surfaced many of the same contradictions within hacking cultures. In asking for a more equal treatment of women, they faced difficulties finding safety and support for difference. As we next describe, members used feminist framings to continually question their ability and responsibility to change those worlds.

Feminism as a Filter

Some members spoke of taking up a feminist label to cultivate a shared language and a shared set of ideals. A president of one of the feminist hackerspaces put this succinctly: *'Feminist' is a nice scary word...So it makes it easier to find people who agree with [our] values.*" Another interviewee and space organizer recalled the decision process for explicitly naming theirs a feminist hackerspace: *"...you'll keep away a lot of people you don't want. It creates a very explicit filter which will push people away which will be very nice."* In calling these spaces feminist hackerspaces, these organizers and members set up a social mechanism for keeping out those who might have fundamentally different worldviews.

One feminist hackerspace president also recognized the potential for the term 'feminist' to deter people they might hope to invite into the space: *"...Where I hesitate around calling it a feminist hackerspace is a feminist has a lot of nice white lady baggage around it...So we try to make it clear with the rest of the way that we put ourselves forward that that's not we're going for."* To offset what she termed "negative" filtering, she spoke of using the term "intersectional feminist," a phrase featured on the front page of all three feminist hackerspaces websites during the time of our observation (2 of the 3 at the time of writing). According to prominent critical race theorist Kimberlé Crenshaw, whom this member cited, intersectional feminism recognizes that there are a multiplicity of factors that influence social prejudice and injustice and these factors interact with each other resulting in oppression that varies in degree and intensity. Such factors include, but are not limited to, race, class, gender, ability, and sexual orientation. Other members cited work by Lisa Nakamura and Virginia Eubanks, both of whom interweave questions of social justice surrounding race and gender with analyses of IT cultures. The president spoke of using the term to disassociate from past feminist movements and to represent the group's interest having a membership that is "diverse" or "inclusive."

"[A] lot of us are nice white ladies and we try not to be jerks about it and we really - try - we try to look at history and try not to do the same damn [thing...]. And since the feminist movement keeps on doing that. [...] I would feel weird being all yes, we're an antiracist hackerspace when most of our members are white. So I guess there's kind of that sort of aspect of not quite knowing how to talk about it."

In this excerpt we see feminism portrayed as partially aspirational. The present member base (mostly white, mostly well-educated, and mostly well paid) did not necessarily

represent the group's desired membership or set of ideals (emphasizing ethnic and socioeconomic diversity). Members described attempting to cope with this discrepancy by acknowledging legacies of marginalization embedded in efforts to promote women's values.

Feminism as Framing Device

Consider a specific case of collaborative technology development entitled "Plastic Fantastic." discussed by two members of Portland Flux as inspired by what one called "critiques of technology development" in feminist writing, such as the article by Sophie Toupin [48]. Specifically interested in aiding projects that did not use computers in the manipulation of the material, this member described providing support for creative work using plastic. During the event, he helped two local hot sauce makers create a funnel that they could use to adapt an industrial food processor to better receive the thousands of peppers they handle during a job. He recalled getting pressure from another visitor to use computer-based technology during the process. In defense of their low-fi approach, he enumerated the amount of time and new knowledge it would take for the farmers to develop a solution with computational technology: *"10 hours...to learn CAD...3 hours to build his first model...this is a large object so it'd take 8-10 [hours]...to print it."* Even with all of that time the problem still would not be solved because the plastics that come out of 3D printers are not food grade.

Reflecting on this interaction, the interviewee and open house facilitator deemed this man's continued push for 3D printing "technological chauvinism," in that the 3D printer would not solve his problem – i.e. in addition to the cost and speed, none of the plastics that would have come out of the 3D printers would have been food grade. His colleague's sense of superiority, he explained, was the result of *"computer people, because they earn a lot of money, [assuming] that their skills are therefore inherently valuable."*

Here we witness on a small scale how, in Judy Wajcman's words, "technological change is a process subject to struggles for control by different groups" [49]. The member questioned the underlying assumptions made by that "technological chauvinist," that learning CAD and 3d printing would be valuable to the farmers, and rejected them based on alternative values. Rather than requiring the hot sauce makers conform to trends in DIY manufacturing, he advocated for the development of a solution that he felt would get them back to hot sauce making most quickly and easily. By restricting the open night to only include development without digital technologies, the hosting member and the space privileged a type of knowledge that is marginalized in other technical, but non-feminist contexts.

Moves like these helped members call attention to themselves as knowledge producers not only within hacker communities but also beyond. A member from the Portland Flux hackerspace, for example, told us that members received frequent requests for interviews from various media outlets every other week since their inception. Industry also

focused attention on these and similar groups. During the spring of 2014, Intel sponsored two small conferences related to hacker and maker culture, both of which hosted a panel on women and hacking.

Feminism, in this way, symbolized not a conventional plea for equality as expressed by popular books such as Sheryl Sandberg's *Lean In* (often dismissed or admonished by members), but an attempt to trouble gender categories, draw attention to reflexivity and, in some cases, introduce a filter through which only certain people might approach members or attempt to join the group. The term also contested a static gender identity, enabling members to both justify and inspire their attempts to redefine technology design.

DISCUSSION

So far we have seen a variety of collaborative forms emerge in the feminist hackerspaces we studied. In some ways, these spaces operate much like other hackerspaces. Usually full of tools for making and modifying, they attract people interested in learning engineering competencies, meeting like-minded people, and building artifacts in their spare time [4,26,47]. However, as we have seen, these spaces also differ in some notable ways from more conventional sites of hacking and hobbyist technology development. For one, organizers grapple with their relative privilege and desires for 'openness.' Even as they advocate for diversity, members create physical and organizational mechanisms for selectively limiting entry such as codes of conduct. While they use the term *hacking* to describe their work, they hesitate in embracing a hacker identity. And though they often voice distain for popular accounts of feminism within IT development, their interests sometimes closely resemble strategies promoted by many of those accounts (impostor syndrome workshops, scholarships for membership, for example).

Despite these apparent inconsistencies — and partly in response to their continued reappearance — members find ways of promoting their own practices and ideals. To call these spaces *hackerspaces* or sites of *hacking*, members deliberately subverted and reframed the extant language of DIY, innovation, and selfhood within computing engineering cultures. As technology scholars have noted, the rise of hackerspaces has followed the emergence of hackers as particular kinds of people: the 'amateur expert' [34], the open innovator [26], and the curious tinkerer [4]. By aligning their work with these technical profiles, feminist hackerspace members aimed to legitimate their experiences within cultures of engineering. In the use of looms they hacked technology legacies: purposefully incorporating alternative histories of female labor into technology innovation. By carving out a space for identity work, they hacked the self: revealing subtle and intimate forms of innovation in their reflexive analyses. These realignments were not merely linguistic, broadening definitions of hacking. They also assumed different bounds to hacking and technological innovation through the new experiences they brought about.

Returning to Johanna Sefyrin's question raised above, how women could be considered insiders in IT design, hacking, or engineering cultures, more broadly had to do with not only how they defined these concepts, but how they propagated the definitions to others outside their hackerspaces (media pundits, other hackerspace members), using narratives of production to reaffirm them.

The sections that follow consider how these practices reinvigorate questions of access and recognition in CSCW and for two core concepts, in particular: (1) *invisible work*, and (2) the *space-place* distinction. The first concerns issues of access and legibility, a theme connected to our first and third research questions; the second concerns what makes these sites places and spaces of hacking, a debate linked to our second research question.

Invisible Work and Partiality

In *Making Work Visible*, Lucy Suchman outlined the tradeoffs of rendering certain aspects of work practices visible to others within organizations [45]. Star and Strauss [42] expanded this argument, elaborating the circumstances surrounding different labor conditions. They highlighted the taken-for-granted nature of workers, their acts of working, and their products of work across varied domains from domestic service to nursing interventions. Further distinguishing these modes of visibility, Nardi and Engeström [32] identified four categories of invisible work: (1) work done 'behind-the-scenes,' (2) routine or mundane work that necessitates considerable competence and knowledge, (3) work done by people out of view, and (4) ad hoc work crucial to an organization's functioning.

In some ways, the activities we observed among feminist hackerspace members fit comfortably within this framework. The work that once appeared routinized, undocumented, or otherwise removed from engineering cultures — child rearing, craftwork or identity — became freshly visible under the rubric of hacking and tinkering. Members called attention to different skillsets, such as the proficient use of looms, in validating their acts of making. Still, as Star and Strauss [42] warn, exposing these skills also meant creating potential burdens of communication and opportunities for surveillance, as demonstrated by the emergence of 'hate mail' and members' wishes to remain anonymous during the course of our study. Rending work visible meant weighing invisibility against exploitation.

However, in other ways, the feminist hackerspace members we studied had their own ideas of visibility. In constructing their sites, they (more or less intentionally) made the space available to some people and not others — providing wheelchair accessibility with limited access to public transportation, for example. In doing so, they learned what kinds of visibly they hoped to engender, what Donna Haraway would call *partial perspectives*. A scholar known for her defining feminist critiques of science and technology, Haraway [16] describes such partiality as limited comprehension of the differences between ourselves and others —

“even when the other is our own machine” [16:583]. According to anthropologist Marilyn Strathern, influential for her studies of gender relations in Melanesia, “partiality is the position of being heard and making claims;” it is fully engaged and yet highly specific [43].

In the course of exposing invisible work, the members we visited made partiality a condition of being seen – whether by potential members, the media, or inquiring design-researchers like us. Understanding their practices as necessarily limited and located, they embraced the dual meaning of partiality. They recognized the *power* and *appeal* of hacker cultures while carefully *limiting access* to their space based on time, location, and social circumstance. In aligning themselves with hacking cultures, members made themselves, their work and their products known and accountable to engineering worlds while challenging the “view from nowhere” [16], the essential, fixed position from which they may be perceived. Acknowledging this partiality helped members not only declare no form of work inherently visible or invisible (in line with Star and Strauss [42]), but also recognize all forms of visibility inherently partial, as Haraway would have us believe [16].

For CSCW, this suggests understanding the act of making visible (or invisible) as necessarily moral and political – always raising questions around who or what has the *power to see*. Like members of the spaces we visited, CSCW might explore the possibility for a richer relationship between women and technology. For example, alongside studies of mobile dating applications such as Tinder, we could study feminist alternatives such as Siren (<http://siren.mobi>), a recent mobile dating platform designed to allow women to specify their visibility within a certain distance for a limited duration of time. Seeking out and investigating feminist designs already in place invites opportunities for recognizing partiality in CSCW design.

Dis-placing Space

When Harrison and Dourish [17] first drew attention to the difference between space and place for CSCW, the promise of ‘virtual collaborative systems’ helped catalyze a growing interest in digital space. The space/place distinction offered a framework for recognizing the interpretive dimensions of these developments. It suggested looking beyond the structural features of virtual sites to the rich cultural understandings of interaction embedded within them.

Ten years on, Dourish re-examined this distinction, highlighting space, not just place, as a social product. He discouraged a “layer-cake” reading of space and place, in which place might be understood to exist on top of a semi-stable space. Instead, he claimed “the social runs right through any ‘foundational’ account of space” and that “spatialities are relative to the different constituencies, populations, and agencies at work” [11]. This reconsideration echoes feminist critiques within the fields of architecture and planning that have argued that space perpetuates inequity

and have expressed the revolutionary potential of appropriating and reorganizing space [28,50].

Our analysis of feminist hackerspaces suggests we might fruitfully revisit the place/space distinction as part of a feminist critique of design. The people we studied described themselves as members of hacker-*spaces*, highlighting the form of their work environments over the practices within them. Members were highly aware of this sited-ness, often pointing to their relationship with the surrounding neighborhood. For example, organizers of LOLSpace, the Oakland collective, rented space in an ethnically and socially diverse enclave of East Oakland, next to particular activist and outreach community-service organizations such as Eastside Arts Alliance and the Bikery, a not-for-profit community bike repair shop. Organizers of Double Union, the San Francisco feminist hackerspace, similarly located their room adjacent to a women's health collective. A feminist concern for spatiality involved choosing a location with care: selectively aligning their site with others developing within and around them.

Moreover, the *spaces* created within the hackerspace (documentation stations, mailing lists) — and the *places* they housed (sites of identity management or failure) — helped members move their understandings of access from abstract and authoritative positions to more vulnerable and embodied ones. Warning of such abstractions, Leslie Weisman's [50] feminist critique of built space illustrates the multitude of discriminatory forms architecture can take: whether separating out the sitting room (for women) from the billiards room (for men) or placing the (mostly male) executives in offices overlooking the city while their (mostly female) staff sit in crunched communal spaces below. She shows us how the design of both space and place can contribute to the sites that oppress women as well as enable their liberation – producing homes, for example, that support different experiences of women's life cycle, from childhood to widowhood. The members we visited acknowledged these cultural and historical contingencies while trying to establish a proportionate commitment to gender equality in space *and* place design.

As CSCW continues to wrestle with notions of space and place, this work points to possibilities for a productive feminist encounter with new forms of mobile and collective practice. Embracing partiality, studies of mobile collaborative media such as Twitter or Skype might call attention to the limited perspectives produced by the routine spaces they reveal and the places they inhabit, such those enabled by the design of car interiors. As one hackerspace member redesigning these features explained to us, “*with minor infrastructure changes such as the disappearance of an ash-tray, nothing's changed since 1950 [...Cars are] designed by men [...]. And women and mothers are super users...*” Much of what members considered in designing space was built on their partial and reflexive understandings of place.

CONCLUSION

In *Designing Culture*, feminist media scholar Anne Balsamo argues for understanding technology innovation as not only the development of gadgets, media forms, and networked communication platforms, but also the range of human practices it makes possible. “The *real* business of technological innovation,” she explains, “is the reproduction of technocultures over time” [2:4-5]. If designing devices entails designing culture, a similar argument surfaces within the hackerspaces we visited. The technological innovation encoded in hacking practice becomes less about the resulting products (micro electronics, woven garments, reflexive subjects) than the cultural shifts they engender. By making their activities visible to wider engineering cultures (in blog posts, panels, conferences, press inquiries), members call for popular media, industry and academia—those who consistently disregard the cultural consequences of technology innovation—to attend to the moral implications of hacking: who gets recognized, who recognition effects, and why. Hacking refigures culture, not only technology.

However, in the sites we visited, practices of hacking call forth something more — what Harrison, Sengers and Tatar have described as ‘epistemological trouble’ in their reflections on ‘third paradigm HCI’ [17]. Harrison and colleagues rely on feminist science studies to formulate unified alternatives to established conceptual frameworks within HCI like claims to universal objectivity. In the communities we entered, this surfaced through inclusive forms of exclusion and inclusive form of exclusion. By troubling the boundaries between inclusion and exclusion, members entangled the dominant discourse on accessibility: showing us how no technological relation is inherently so, but that they are constitutively and productively intertwined [3].

This argument has implications for not only hacking research, but also how CSCW treats categories such as *women* and *technology*. If a dominant paradigm projects women as unfit for, or uninterested in technology development, feminist hackerspace members presented a compelling alternative: women as ideal agents of technological change. By wrestling with definitions and rules for membership, they called attention to the productivity of materializing difference within a conventional technological paradigm around women and technology.

In this sense, we find a compelling parallel between the forms of hacking at play in the feminist hackerspaces we investigated and women’s relations to technology development more broadly. Efforts to increase the participation of women in design and engineering fields involve circumventing a naïve belief in biological (or sexual, or racial) essentialism. Like our feminist hackerspace members, the practices of women in relation to social systems and media are “not the expression of essential feminine insight” [2:33]. Instead this case highlights the importance of recognizing the diverse gendered forms and modes of technology development already underway. From “failing open” to

“failure club,” these breakages and ambiguities enable us to reconsider how women’s relations with technology might be actively changed.

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