Title
Design through Inversion: Entanglements of feminism and design in two workshops

Introduction
Feminist science scholars and design historians have consistently highlighted how objects, spaces, and systems have been designed in ways that delimit the ability of certain groups to act upon the world. Even when members of these groups have contributed to the work of design, it is not uncommon for their efforts to go unattributed or overlooked within traditional engineering environments (Allhutter 2012; Sefyrin 2010). This paper draws on feminist design studies (Bardzell and Bardzell 2011; Matrix 1984; Weisman 1994) and infrastructure studies (Bowker and Star 2000; Star and Ruhleder 1994) to examine efforts to refigure these developments through feminist hackerspaces: collaborative workspaces developed to recognize and enable women's pursuits within predominantly male engineering cultures. Using interviews and action research in Northern California and the Pacific Northwest, we begin to trace how the reimagining of everyday space — how it might look, feel, and interact with society — became a means of grappling with the alignments and disconnects between feminist principles and infrastructural design. Following Star and Ruhleder (1994), we use the term infrastructure to not only mean underpinning systems like plumbing, electrical power, or fiber optic broadband, but also those of the cultural and historical sort, like the governmental and business mechanisms that lead to the construction of a power plant or the familial commitments of residents. Moving onward from here, we specifically examine the case of two 'feminist design' workshops, daylong events we held in the spring and winter of 2014 as part of our ongoing collaboration with feminist hackerspace members to reimagine their everyday environments beyond the hackerspace and typical realms of technical practice. Through sketching and photo-elicitation (photos prompting conversations before and during our workshop), we called on members to develop design concepts that relied on infrastructural inversions (Bowker and Star 2000): analyses highlighting the sociotechnical assemblages underlying local, mundane sites and everyday tools. This inversion offered members a means of resisting the tendency of infrastructure to disappear and "recognizing the depths of interdependence of technical networks and standards, on the one hand, and the real work of politics and knowledge production on the other" (Bowker and Star 2000).

As we describe in the paper that follows, our two workshops highlighted a multiplicity of feminist approaches central to both the hackerspace members with whom we worked and the notions of design to which they ascribed. By expanding the category of 'feminist design' to include a broad range of concerns and practices, we show how the process of inversion begins to suggest a different set of goals and expectations for design. By attending to broad questions raised by inversions of software and systems we reveal a plurality of feminisms in these settings and the importance of revealing these differences in perspective. We end by discussing how feminist design approaches entail a consideration of how infrastructural inversion works (or fails to work) as part of an examination (feminist) design projects.

Feminism and Design
Our motivation to consider feminist hackerspace workshops stems from an interest in histories of feminist interventions in the built environment. Architectural historian Dolores

Hayden, for example, traces feminist design back to the work of American progressive era material feminists who believed that women should have social equality and economic independence (Hayden 1982). By forming housewives' cooperatives, kitchenless houses, day-care centers, public kitchens, and community dining halls these women re-designed domestic spaces to promote a less isolated existence for women. Similarly, design historian Caroline Constant used postmodern feminist theory to reexamine the work of progressive female architect Eileen Gray of the Modern period, whose architectural work had been under-recognized and unpreserved to that point (Constant 1994). These efforts to expose undercurrents of inequality reaffirmed through architectural form offer new interpretation of design history that recasts women as active influences on highly regarded planners and designers like Lewis Mumford and Ebenezer Howard (material feminists) or Le Corbusier (Eileen Gray), rather than passive onlookers.

Matrix, a design collective stemming from the socialist New Architecture Movement (NAM) in the late 1970s, provides an example of definitively feminist design practice. The group originally began meeting to discuss issues like ending sexist advertising in building press and were reportedly troubled by the lack of published work on topics of architecture and gender (Matrix 1984). They soon developed into a formal feminist design collective and were comprised of architects, sociologists, builders, carpenters, and a housing manager. Their work centered on recognizing and sharing the ways in which the built environment affects women in society so that they could then use that knowledge to subvert the "man-made" environment. This agenda took on multiple modes of execution, involving exhibition, practice based and written work. Notably, they wrote a book entitled *Making Space: Women and the Man Made Environment*, which offered critiques of current architectural design practices, highlighted the ways in which designs inhibited the movement of women through space, and provided records of some of their own design projects. Their practice-based work was done through publicly funded social projects and by offering advice through community technical aid centers. Their research and design was intentionally focused on spaces that were typically overlooked by the male-led architecture industry like women's centers and nurseries. They also developed and documented participatory methods of design based on "collaboratively defining how a space could be used, discussing how the space would shape people's relationships with one another, sketching multiple designs, and sharing the sketches with local groups and at public meetings" (Matrix 1984). By producing alternative designs through more participatory methods, they hoped to eventually influence the broader architectural community. In the meantime, they were actively producing public projects that suggested alternatives for how the world was currently constructed.

Feminist approaches to design have more recently emerged within the fields of interaction design and human computer interaction, spearheaded by researchers like Shoawen Bardzell (Bardzell 2010) and Jill Dimond (Smyth and Dimond 2014; Dimond 2012). Bardzell identifies feminism as a "natural ally to interaction design," pointing to shared commitments to equity, social justice, empowerment, and a capacity to reveal opportunities for intervention. She asserts, "feminist approaches can integrate seamlessly and productively in all stages of the design process, including user research, prototyping, and evaluation" (Bardzell 2010). With colleagues in the Cultural Research in Technology

group at Indiana University, she has also produced feminist and critical designs like Melody Bot, which takes a playful turn on the quantified self movement through the manipulation of video of extended computer use.[1] By mapping qualities of pluralism, participation, advocacy, ecology, embodiment, and self-disclosure to design projects she is creating a means by which current and future design can be systematically evaluated.

Taking an interventionist turn, Smyth and Dimond propose an Anti-Oppressive Design framework as a guide for information technology (IT) developers designing for 'social good' (Smyth and Dimond 2014). Inspired by scholarship within the field of social work (Burke and Harrison 2003), they develop the framework to aid in the understanding and response to oppression in its complexity. They suggests developers ask themselves a series of questions before implementing or agreeing to work on a project: "What oppression would this work strive to eliminate? On what level? At which intersections?" Though seemingly simple, these questions ask the designer to do the work of recognizing the structural barriers and privilege that might be at play before the development of any IT begins. Here, that note that "obviously problematic endeavors" like taking on military contracts would not make it past this scrutiny, but neither would more subtle projects like ones focused on improving social services instead of working toward structural change. These questions also require the designer to articulate the change they are trying to enact, which in turn highlights their agency and position in the process.

Similarly generative, Science and Technology Studies scholar Doris Allhutter offers *mind scripting*, a feminist decontructivist approach to software development (Allhutter 2012). The method was reportedly inspired by critical design and its aim is to support reflective work practices that investigate "processes of the co-materialization of gender and technology." The process involves participants identifying an issue central to the design process and then writing a short third person account of a memory involving that issue. Then all of the participants do the work of collectively deconstructing the texts, looking for indication of subjects, activities, emotions, and motivations. The method offers designers a procedural and tangible exploration of gender performativity that is context-specific.

These projects signify a small but growing literature concerned with generative (feminist) framings within technology cultures. For example, Smyth and Dimond and Allhutter respectively offer two approaches for how designers might recognize subject positions and power relations within contexts of IT development. These approaches offer direct and tangible ways for researchers and practitioners alike to critically and productively explore alternatives to current design situations. Nelly Oudshoom and colleagues (Oudshoorn, Rommes, and Stienstra 2004) confront similar design logics in their case studies of two projects in the public and private realms, led by City of Amsterdam and Philips Research respectively. In both projects, the designers aimed to design for all users. Oudshoom and colleagues found that this goal connected with a reliance on what the authors call the "I-methodology", an approach in which designer relies on their own personal experience to guide design decision making. Ultimately the I-Methodology limited the reach of the design project, creating systems that appealed to mostly young, technically inclined males. By

[1] http://crit.soic.indiana.edu/about/

identifying potential roots for the exclusionary design, the authors emphasize the potential for change. Oudshoom et al. conclude that the "identities of designers are equally important in understanding the dynamics of technological development" (Oudshoorn, Rommes, and Stienstra 2004). In offering explanations on how designers failed to consider the diversity of users they were reportedly designing for, Oudshoom et al. offer an entry point for interventionist modes of inquiry.

Interventionist modes of inquiry have pervaded strains of art practice and speculative, adversarial, or critical design since at least the Situationalists (Dunne and Raby 2001; Dunne and Raby 2013). From the Gutai group (Schimmel, Stiles, and Angeles 1998) to Survival Research Labs[2], a tradition of performance art has highlighted the meanings forged through action and intervention, using technologies to question assumptions about our social worlds and the place of the technical within them. Similarly, cultural probes (Gaver et al. 2001) and other forms of intervention fit comfortably in this form of inquiry. Here the work of building serves to extend and restructure the conceptual frameworks that order daily practice. Originating out of industrial and product design, traditions of critical design (Dunne and Raby 2001; Dunne and Raby 2013) open potential avenues for questioning the "status quo" of product development, emphasizing values embedded in the built environment (e.g. tool, spaces, and systems) and design potentials that may exist in the future or in an alternative present. The resulting objects often embody criticisms or re-imaginings of political, environmental, and social issues. The goal of the production of critical design artifacts is to provoke audience members (consumers and designers alike) to question assumptions and preconceptions about the role consumer products play in our lives and to inspire them to imagine alternative futures

However, concerns for visibility and labor politics underlying technology design remain difficult to account for using such critical design approaches. Exploring the construction of technology from a different angle, Bowker and Star (2000) look to infrastructure, the pervasive social and technical networks and standards that often go unnoticed but make up the goings on of daily life. These systems and structures become visible only upon breakdown (unless, of course, it is one's job to repair them). The purpose of the inversion they propose is to recognize "the depths of interdependence of technical networks and standards, on the one hand, and the real work of politics and knowledge production on the other" (Bowker and Star 2000). Bowker and Star compare this to an argument featured in Art Worlds, in which Becker articulates the ramifications of an extended musical performance on the communities of artistic practice that support it (Becker 2008). Conventions and constraints among parking attendants, ticket takers, and theatre rentals all have to be stretched and rearranged for the unusually long performance. In this case, the performance highlights the structures that are currently in place. Bowker and Star suggest a direct, interventionist approach that allows people to interrogate infrastructure at any time, rather than just when something unconventional happens to occur or some part of the established system breaks down. In choosing to use this approach as the framing device for our second workshop we highlighted how the design decisions around often out of sight structures have the ability to guide and arrange social action. In particular, Bowker and

[2] http://www.srl.org

Star offer four methodological themes for infrastructural inversion, which served as the basis for our workshop activities: ubiquity of classifying and standardizing, classifications and standards are material, the past is indeterminate, and the practical politics of classifying and standardizing.

We take up these concerns in our own set of interventions in feminist hackerspaces. Since 2012, Feminist hackerspace members have developed these spaces as collaborative sites with which to support the creative and professional pursuits of women. Sophie Toupin, a feminist scholar and member of a feminist hackerspace in Montreal, describes these sites as the "spatial manifestation of the feminist hacker, maker and geek culture" (Toupin 2014). Though all different in their implementations, these spaces share a core tenant that women and other marginalized people should be welcomed to perform technical practice without being subjected to discrimination or abuse. Liz Hendry, co-founder of Double Union in San Francisco, notes that feminist hackerspaces, like many other hackerspaces, focus not only on making, but also teaching and learning. Where they start to diverge is around the values they aim to uphold and the activities they serve to promote. Noting difference, Hendry adds, "[ours] is starting with a few extra values: intersectional feminism, support for feminist activism and strong respect for personal boundaries" (Hendry 2014). Sophie Toupin further explains that members of these spaces share an ideal "about creating a space where agency, fulfillment, empowerment, diversity, and social justice is its core," rather than centering themselves on a principle of uninterrupted openness (Toupin 2014). As a safeguard against harassment, these spaces established codes of conduct intended to communicate institutional values. Without these codes, members might face the burden of having to continually explain their viewpoints. As Toupin notes, "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" (Toupin 2013). Through material and discursive engagement, members of these spaces contest widely understood forms of hacking and technology development. By reframing activities rarely associated with technical work (e.g. weaving, identity workshops), they open up hacking to a wider set of individuals, allowing room for practices that do not sit neatly within wider corporate or popular hobbyist technology culture.

In the following section, we explore feminist hackerspaces as sites where feminist design is currently taking place, both in the spatial reconfigurations members are pursuing and in the activities they choose to support.[3] Though we initially drew on approaches to speculative design outlined by Tony Dunne and Fionna Raby (Dunne and Raby 2013; Dunne and Raby 2001), we were less interested in the designer-consumer framing prevalent in much of their work. Instead, we focused on the (infra)structures framing design processes. We hoped members would begin to direct their attention on points of their lives often missed at first glance, but nonetheless affecting the way they are able to live.

[3] Participation within the two hackerspaces we worked in was notably white (or Asian in the case of the first workshop) and college-educated.

Operating an Infrastructural Inversion: **Two Design Workshops**

In the first few months of this research, our focus was on observational study of feminist hackerspaces in Seattle and Portland (Citation removed for blind review). We took the workshop as an opportunity to speculate on the types of things that might inform and generate ideas for the participating members. We were particularly interested in putting together a design agenda that could extend members' personal and collective concerns, recognizing their organization of the space as a productive act, enacting particular values and ideas in relation to a broader technology cultures. Our workshops used these concerns to investigate the shape and character of a feminist approach to design. Central in this project was an infrastruturing of design decisions: recognizing how inverting our perspective — highlighting the sociotechnical assemblages underlining our design projects — could offer possibilities for rethinking technology design.

Our first workshop came about through an unexpected invitation. In preparation for a field visit to Double Union in San Francisco, one of the co-founders asked us to facilitate a design workshop in the space. Rather than designate a topic for the event, she encouraged us to choose whatever subject we felt most comfortable leading. In extending this invitation, she allowed us to move beyond a purely observational position, into one that might be more interventionist — and more immediately useful to the group in comparison with our academic papers (which we shared later that year).

Our first workshop built on Dunne and Raby's (2013) speculative approach by framing feminist hackerspaces as instances of critical design. The organizers took on the responsibility of publicizing the workshop to their members via their blog, email list, and Twitter. They recruited 15 of their members to participate. Members were exclusively female and overwhelming majority worked in the technology industry in some capacity. The week prior to the workshop, we asked participating members to take part in a photo elicitation activity, which involved capturing images of their environments. Photo-elicitation is an ethnographic technique that uses photo taking and sharing on the part of the participants to emphasize the "respondent's voice in expressing values and value judgments, mitigating the assumption of researcher as authority" (Le Dantec, Poole, and Wyche 2009). In developing the activity, we selected a series of words repeated across interviewees from the transcripts we had done in the Seattle and Portland spaces. These phrases served as prompts for the activity and included things like "filtered space," "authoritarian space," "co-opted space," "inclusive space," and "social space." In interviews, these terms had been used to describe the feminist hackerspaces themselves or spaces that they were purposefully trying to avoid emulating. For the photo elicitation activity, we did not give members the source of the phrases, instead we asked them to interpret the words however they liked and capture a set of five spaces they felt matched these terms. The photos then served as the basis on which the main design activity was formed.

While organizing the workshop we noticed the physical layout of the space also offered a point at which members establish contrast to other, non-feminist hackerspaces. Members of Double Union described explicitly trying to create clean environments with 'open' features. Seattle Attic members removed an office door bisecting their space. Similarly, several members of Double Union took out tiles to a ceiling they felt was too low. In doing

this, they revealed 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 installed. A Seattle Attic 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 (Gelber 1999). Not just a matter of preference, Cheryan et al. have found that the physical layout of computer science classrooms can impact gender participation (Cheryan et al. 2009). Through a series of experiments at universities in the United States, researchers found that the presence of objects stereotypically associated with male-dominated geek and computing cultures (e.g. Star Trek poster, video games) do the work of broadcasting those stereotypes to newcomers and can deter those who do not identify with those dominant groups.

For the first portion of the design activity, we asked members to divide into groups of two or three people and identify present challenges in the spaces their photos depicted. The members then developed possible design interventions for addressing these challenges. A final design activity involved the members imagining what these spaces might have looked like in the past and about how critical design could have been used to intervene to effectuate changes that would have lead to their ideal present and futures.

One group chose to think about design interventions for a mansion owned by public figure and romance novelist, Danielle Steel. Her house had been the cause of much controversy in the city. It takes up half a city block and is the largest single-family lot in San Francisco. Because of its size and Steel's status as a public figure, many residents and tourists have tried to photograph her home. One participant said that, in order to combat the curiosity of strangers, Steel planted illegally tall hedges with an embedded electrified fence. Unsurprisingly, this led members to sense that Steel's status as a wealthy public figure meant that she did not have to comply with city regulations like everyone else and that her preference was being privileged over people's safety. To remedy this situation, the members first aimed to somehow encourage Steel to meet compliance with city regulation, which would in turn show the community that she was "a citizen that follows the same [laws] as everyone else," they explained. They felt that holding her to the same legal standards would change public attitude toward her. They proposed altering the use of her space. For example, one participant noted that Steel's mansion "has a huge lawn… you never see a big flat lawn area in San Francisco… So, we thought that you could have events or sporty things for kids there, some way to make it more of a community space." The participants also brainstormed ideas about what the home could be used for in the future. For instance, they envisioned Steel leaving her home to the community in her will and the mansion becoming a public library or museum.

Here the re-design depicts a lack of reflexivity. Just as members presented ideas to reimagine the Steel mansion as a public site, they reinscribed boundaries between themselves and its tenant, Danielle Steel. Their suggestion for Steel to succumb to public pressure, turning her house into a museum, invokes a notably anti-feminist notion of 'othering' Steel. Although this team was mostly concerned with increasing the San Francisco community's interaction with Steel, they explored how this could be accomplished through interventions in and around her private home that undermined our project for ethnical (feminist) design alternatives.

Much of conversation in this first workshop involved that which was visible: shared space in a coop, a disorganized office, a subway station, and a mansion the size of a city block. This is not at all surprising since we asked participants to come in with photos of certain types of spaces. It is quite reasonable that they would focus on elements of the space that could be seen, considering that physical components of the environment do seem to limit them regularly. Moving onward from the first workshop, we wished to refocus the design activities so that there could potentially be more discussion of the infrastructural constraints that preclude members to behave the way they wish outside of the hackerspace (or what some members called the "real world"). Moving into our second workshop at the Seattle Attic, we turned to a notion of infrastructural inversion, which Bowker and Star describe as an intentional "struggle against the tendency of infrastructure to disappear (except when breaking down)" (Bowker and Star 2000). Unlike the Double Union workshop, the Seattle Attic event was open to the public, which meant that whoever encountered the event online was able to attend (including both self-identified males and non-members). Organizers planned to host an open house the following day and used the workshop breaks to announce this and other hackerspace information to others (multiple times). "This is the biggest group I've seen in this space," a member explained.

Our restructuring of the workshop activities highlighted the infrastructural elements of everyday tools and the concerns they raised for the people participating. Before attending the workshop, we distributed a series of questions in an open-ended survey format, asking participants to describe a time when they encountered an idea they disagreed with reinforced in the design of a technology. Upon entering the space, participants individually engaged in a rapid re-design of the contentious technology they brought up in their survey responses. They did not share the results of this process, instead this was meant to serve as a basis for the later pair design activity. We then offered up the examples they had brought in to serve as basis for group discussion. Along the way we introduced the concept of feminist design and asked participants for their accounts of feminism. After the initial discussion, workshop participants paired off into groups for the re-design activity.

Before introducing our design activities, we asked people to share their thoughts on feminism, hoping to foster a dialogue on feminist design. This revealed a variety of feminist concepts and approaches. One woman in her mid-fifties connected feminism with a particular image of equality: "Today everybody gets equal pay. There are no barriers for women." Another connected feminism to "the opportunity to be able to participate in a competitive market, in a safe and ethical fashion." A third person spoke up: "first of all, equal pay, equal rights. Secondly, women have the right to choose what they want to do […]

without the weight and judgment and consequences that men don't have to pay." A forth person disagreed: "I think of feminism as being much broader than being just about women, but about all folks. And about having the opportunity to participate and to define for ourself individually how we want to move through the world."

Our conversations around feminist approaches to design continued as we presented two design projects: a dating application for women and a women-oriented hackerspace design project to re-design the family car. One woman explained: "I think the thing is for me with feminism is that it's also about providing alternatives that you can see that there is a dominant [voice]…and other voices." Echoing concerns of Oudshoorn, Rommes, and Stienstra's (2004) I-Methodology, another person explained: "Designers, even though they're not designing for everyone, [they] try and bill it as designing for everyone, which is annoying." This resonated with another perspective: "[it's] hard to design for a group that you personally do not understand." Another person pushed back at the alignment of these projects with feminist values, saying: "I think at heart it's still an app for dating and it's still a car for driving kids. I think these both still are entrenched in capitalist structures that are perhaps anti-feminist." "Yeah, these are alternatives for people to participate, but they're still fundamentally reifying those things and kind [of] segmenting our society more. 'Well, I'll just go on this app and find who's on there,'" someone else explained. For the people participating, 'feminism' not only called forth concerns for transparency but could also suggest revamping the socioeconomic structures on which different projects get built. People's differing feminist perspectives troubled feminism as a coherent framing.

Pre-activity: an idea you disagree with reinforced in the design of a technology
We received a wide array of answers to our initial call for technologies reinforcing problematic concerns. For instance, a woman with a fashion design background took issue with the practice of designing tablets for children (e.g. Samsung Galaxy Tab 3 7.0 Kids Tablet) and a former policewoman discussed the design of bodysuits, which inevitably did not fit a woman's body. Others were more troubled by technology nomenclature than any particular design. One woman specifically noted the practice of calling input ends of cables "male" and the corresponding receiving points "female:"

> *I think using these terms reinforces a gender binary, but also is a strange context in which to conflate anatomical references to biological sex with technological devices. Although it is a seemingly trivial example, I feel like it reinforces notions of dominance through the reference to and act of insertion and receiving.*

In this snippet from her survey response, we see how this woman began to problematize a colloquialism associated with conventional electric cables. Like the classification of disease described by Bowker and Star (2000), this comment describes a type of infrastructural inversion that reveals the role of common technology conventions (input / output) and associated nomenclature ('female' and 'male') in perpetuating a gender binary. The cables work as part of a complex and tangled web of human knowledge and interoperability (see Bowker and Star 2000) wherein the respective input/output mechanisms imply authority and passivity. By questioning the construction of this norm, this woman implicates the cable in a layered sociotechnical system conflating sex with gender. Paired with the terms

'male' and 'female,' we start to see not only a patriarchal understanding of the world, but also a heteronormative one. This inversion helps expose a politics to the standardization of this input/output binary. The examples that follow exemplify inversions such as this cable analysis that people reworked through a series of re-design activities: *define* the design challenge, *brainstorm* possible re-design concepts, *critique* another group's design concepts, *reflect* on the results of the critique, and *review* the work in combination.

Pronto Bike

Participants raised concerns for gender identification throughout the workshop. A software developer pointed to the required gender survey question in the signup protocol for the Pronto bike sharing service in the city of Seattle. He explained that this question not only reinforced a gender binary, but also brought up issues of privacy and a degree of stereotype threat around participating in cycling. He noted that he had tweeted a complaint to the organization, but has to receive a response.

Taking up this survey question in the re-design activity, the software developer and a former police officer, highlighted how this question not only provides a reductive interpretation of gender, but it also indicates importance in what they called the "conventional order" of possible answers, with the male selection typically coming first. The software developer noted that the pervasiveness of this organization "[is] so basic that [he] hadn't even thought about it. It had to be pointed out to [him by another workshop attendee]" and that it "seems to imply some sort of precedence."

Moving on from identification of the question and its answers as the site for their re-design, the two contemplated alternatives. In describing their process, they mentioned consistently coming back to "just [letting] people write in what they are." They figured that there have been sufficient enough advances in text analysis software to handle interpretation of freeform responses. With its reliance on predefined categories, the two speculated, "[…] it's a design that prioritizes the convenience of the people who design it and deal with the data afterwards," rather than survey respondents. They strongly preferred making it an optional question, unless it was something that was necessary to know to give proper service. If this were the case, they suggested being more forthright about what the service provider plans to do with the information:

> *Depending on what they want to do with the data, they may care about sex more, they may not care about gender more; then they may actually care about both… whatever it is, if they spend the time to figure out why are we asking this question? What will we do with this information? And therefore does that change whether we should ask it, how we ask it?*

The team advised that the bike hire ask service-specific questions. Rather than inserting conventional gender questions to infer something about the user, they suggested asking the question they were really asking. If the hire service was concerned with making sure there were enough helmets or bikes of certain size, for instance, they could simply ask users to provide a preference. If there was interest in collecting demographic information for the purpose of tracking the user group, then the survey could feature descriptions of what the

data would be used for and why (e.g. results to be included in an annual report or in a grant proposal).

This suggestion, however, overlooks potential relations between gender and service. The designers of Pronto might have sought out information that would inform the design of bikes for their female users. The teams viewed the sheer presence of the gender question, even if optional and with freeform answers, as asking users to synthesize their gender identity for later use by capitalist or governmental intuitions. In thinking back on the Anti-Oppressive Design framework (Smyth and Dimond 2014), we start to see how team members were making changes within pre-established structures instead of breaking them to inspire social change. The team questioned efforts to collect demographic data that might prove widely useful to the city (for instance, winning grant funding) by imagining an alternate situation within the current political and economic conditions of the service. Even as the team recognized a reliance on conventional gender categories within the bike hire service, they fell short of offering a radical alternative.

Street Path

Concerned about the navigability of intersections leading to light rail stations in downtown Seattle, a Seattle Attic member and a Disney engineer worked on a system of textured paths to help people with vision impairments. While brainstorming, they said they felt rearranging tracks or building pedestrian overpasses seemed like implausible solutions. Instead, they offered up a system of textured paths in the crosswalk with "extremely directed audible cues." They imagined that if one were to veer off of the crosswalk they would be warned by variations in the groove patterns of the sidewalk and a significant decrease in beeping.

The larger group reacted positively to the concept, saying things like "this is really cool," but brought up questions around its implementation. One participant wondered how sensitive service animals would be to the groove patterns. To this, one of the team members responded that he understood them to be very sensitive and felt that a "texture could be trained into the dog very easily." Another participant questioned how this system might sit in relation to others: "if you do have a system that works for this intersections - how do you connect it to broader systems of communication and information. So if that is something that you think is part of like a training, how do you make that more universal and accepted?" Here, we see the issues of standards and scale emerging. One of the team members claimed that currently there may be a local standard, but that does not expand out to any one universal system. He said the team would be helping create a new system for Seattle, but that would not necessarily be used in even nearby cities like Spokane. When questioned further about the machinery and training required to make the grooves in the crosswalk work, the engineer on the team insisted that it would not difficult because trucks already exist to do similar texturing in other contexts like speed bump making.

This design directly touches on two of the aspects of infrastructure inversion highlighted by Bowker and Star (2000). The first is that standards and classification systems exist as material and symbolic. The group chose to approach a structural problem (the lack of safe walkways for people with vision impairments) through material means. In this way, they

understood that standards run through the built environment. What is more difficult to parse here is how their system would fit within or without an ecology of already existing (crosswalk) conventions. The related issue of ubiquity also arises here. Though probed on the issue of scale, the team rejected the thought that there might be difficulties in the implementation of the design. This design requires changes to the ground around each light rail station in the city, implicating the need for people (city employees) to produce and maintain the textured marks. Additionally, those patterns would need to be learned by the people and animals who move across them, including the people who train guide animals to recognize particular marks.

Paywall

The third project came from another undergraduate student and a visiting Information Science Master's student. The two reimagined paywalls, online mechanisms that prevent users from accessing certain information without paying a fee. They were specifically interested in those that guard academic articles, seeing them as instances of inequality with respect to access to information:

> *Where I'm coming at from a feminist perspective is the whole equality regardless of gender, race, socio-economic class and paywalls definitely inhibit the flow of information for people who don't have the money.*

In imagining a re-design, they proclaimed that they could not, "just rip out paywalls," seeing a need to generate revenue somehow. In place of having a fixed price on articles or a subscription to the publication, they offered a pay-what-you-can model for individuals and a tiered payment plan for institutions, where big universities would pay more than a small liberal arts college or community library. They also imagined different prices for lower quality scans and allowing for pay-per-section, a la carte style purchases. Another participant recommended that the system have a cap on the amount of profit it could make off any one article. A highly emphasized feature of their design, was what they described as transparency. On purchase page, they proposed publishing information like how many times the article has been downloaded, how close is it to the profit ceiling, and where is the money going (i.e. the author, publisher, website).

This project relates to issues of practical politics, described by Bowker and Star (2000) as having to do with both how standards are negotiated and the decision of what will be visible. When tools such as a paywall establish categories, those categories necessitate the management of conflicting concerns. In the process, certain aspects of the system become more visible than others, which can promote a privileged position depending on the circumstances. In the case of the paywall, the team saw their re-design as an examination and reassignment of power within the "corporate" academic publishing industry. They aimed to provide less expensive ways of accessing the information locked away behind paywalls. However, without first dismantling the publishing industry, their proposal for cheaper and easier information access failed to move beyond a marginalization of the participating authors. Instead, it reinscribed existing forms of marginalization. As one workshop participant responded, "Personally, feel really sad that someone could just take a page from an article that I published, which they're already doing anyway. But to me the

fact that it would be commodified as such would just make it so transparent." Here, the transparency that the team sought to emphasize becomes a means for revealing the lack of power of the author. While the team couches this project in feminist narratives as part of its presentation at the workshop, they did not directly tie their project to feminist concerns. The critiques that feminist designers such as members of Matrix (1984) have built against capitalist structures undermine their project, further muddying any definitions of feminism mobilized for design.

Tinder Facial Detection

During the workshop, a Seattle Attic member and an undergraduate student presented a project aimed at adding search filters to Tinder, a popular image-based, geolocation-specific matchmaking application. An issue with the current application, as identified by the two, was that women seeking men were frequently faced with accidental and unwanted viewings of what they called "dick pics," images of male genitalia. Though admittedly "second hand information" to both of the team members, they described that it was common practice for men on the app to use "dick pics" as their profile pictures, in place of images of their faces. They suggested that filters be added to block these profiles from view of women who do not wish to see these types of images. Here a technical intervention was proposed:

> *Using facial detection software […] so that you can have an option enabled so if you want to see this kind of photo or not…because there are some people who actually want to see these kinds of things. We decided that you can select an option to say 'I'm only interested in face pictures' at least to start with and then the software will only allow you to upload a picture of your face as your profile picture.*

Much of the conversation dealt with the technical feasibility of the project. Specifically, the two contemplated the conditions necessary for the computer to detect face shapes in images. During this phase, they began to define a series of rules that users of the application would need to abide by in order to pass the non-"dick pic" test like adequate lighting and ¾ of the frame being made up of face. While describing the difficulties of implementing the filtering mechanism they admitted that the development would take "lots and lots of beta testing" and ultimately "there's only so much a computer can do" with there are always being "ways to trick the software."

The women identified a technological workaround for addressing behavior that they recognized as undesirable. Though they noted some women might *actually* want to see pictures of their potential partners genitals, this was not understood as the norm. They repeatedly called Tinder a "lazy dating" app and seemingly downplayed its appeal as a means for connecting with proximate strangers for casual sexual encounters. When probed about why they chose to include the option for viewing the images of male genitals, one of the team members replied, "If you're not looking for a relationship, that's fine. If you want to look for a photo for nine inches, that's good. It's just not what I would want." Though admittedly not a part of the user group, these women designed to protect against exhibitionist behavior they felt was undesirable. They continually indicated that, though they wanted to make room for hookup-focused interactions, they were not a part of that

culture. They claimed they were interested in creating a "safe space for those who want it, as opposed to letting people out into the wild," while "not imposing our morality onto somebody else."

This project begins to illustrate how designer's values get imbued in their work. Similar to Oudshoorn and colleagues' (2004) examination of the use of the I-Methodology, here we see personal preference become the basis for a re-design activity. Having never used the application, the team relied on an image of users like themselves who would not be interested in viewing nude pictures or pursuing casual sexual encounters. Though they made room for these types of interactions, their concentration was solely on protecting against what they saw as unwanted heterosexual male behavior. Missing is a consideration of how the existing application is currently used. They might find, for instance, that it takes a relatively high degree of digital literacy to upload and maintain a nude image on Tinder. Accounts are managed exclusively through Facebook so pictures have to move through both systems without getting flagged. In order to get around this, users can set their image as 'private' on Facebook, but this still does not prevent it from being flagged and removed once on Tinder. In light of earlier conversations about how technology is often designed without a proper understanding of users, this re-design appears to reproduce some of the same behavior the team critiqued.

Feminist Dialogues through Feminist Designs

Prior design scholarship has largely construed feminist design as a process of harnessing feminist approaches for the sake of development. Artists, makers and scholars have mobilized feminist epistemologies of equality, difference and intersectionality to reimagine existing relations to technology design and use. This paper has advanced a different view. We saw that when design becomes part of emphasizing a feminist encounter with technology, it must confront the variety of feminisms at play. Entanglements of feminisms and design processes in practice transformed people's ways of knowing and enacting their views. They revealed feminism and design as co-constitutive: transforming one another through their interaction.

On the one hand, our re-design activities complicated the group's relationship to feminism. They highlighted the multiple feminist legacies underwriting the design projects people imagined. The Paywall and Tinder projects revealed undercurrents of second wave feminist movements of the 60s and 70s, presenting the personal as political and dissolving differences between intimate and public spheres. In the Pronto Bike and Street Path projects we encountered legacies of third wave feminist movements of the 90s that problematized the primacy of white, college-educated, straight women and drew attention to merging racial, ethnic, religious and cultural identities. During the discussions of feminist perspectives that accompanied these workshops, differing feminist definitions complicated a process of re-design.

On the other hand, the people participating in our workshops began to transform the very practice and purpose of design: building a range of feminist ideals into the design efforts themselves. Their acts of surfacing and dissolving categories entrenched in standards and other infrastructures offer a response to human-centered accounts of technology

development. In such accounts, stability is central: people explain technology development in terms of the purpose it serves for a person (or social system) rather than its developments, struggles, interferences and so on. Explanations of technology come to ignore the fragility of things, as William Connelly (2013) would describe. In our first workshop we hoped to challenge such accounts by constructing 'feminist' and 'hacker' categories in new ways, explaining them in terms of the particular circumstances of the women we worked with. However, rather than dissolving these dominant logics, our activities sometimes helped reinscribe the very boundaries we aimed to dismantle. The resulting projects (Danielle Steele's Mashion, Tinder Facial Detection) reflected tensions between human-centered and feminist framings. At times, members lacked reflexivity, 'othering' particular urban landscapes and the people within them. At other times, members expressed concerns for equality through difference. In our second workshop, we oriented our questions toward visibility and change: shifting notions of gender identity for survey users, the new pedestrians frequenting particular intersections, the changing economic conditions surrounding Paywalls, and the personal and political tactics of facial detection on Tinder. Still, this human-centered problem-oriented perspective remained. That this became so difficult to overcome suggests a certain strength to the human-centered perspectives written into accounts of technology culture.

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